

ORI

AVIATION AND PROGRAMMATIC ANALYSES

VOLUME I

TASK I - AVIATION DATA BASE DEVELOPMENT AND APPLICATION

28 MARCH 1977

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PREPARED UNDER CONTRACT NO. NAS5-23177
FOR THE NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

Operations Research, Inc.

OPERATIONS RESEARCH, Inc.

SILVER SPRING, MARYLAND

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FOREWORD

This is Volume I of a three volume final report which consolidates the studies and analyses conducted by Operations Research, Inc. (ORI) for the National Aeronautics and Space Administration, Goddard Space Flight Center, under Contract No. NAS5-23477.

WORK OBJECTIVE

The overall objective of this work was to initiate the application of aviation related data base development activities and carry out selected analyses concerning the evaluation and selection of Office of Aeronautics and Space Technology (OAST) Research and Technology (R&T) Programs.

APPROACH

The approach was to execute a series of well-defined aviation and programmatic studies and data compilations which would individually contribute to an improved capability to assess quantitative and qualitative financial and technical aspects of R&T investments and programs.

STUDIES AND ANALYSES COMPLETED

ORI conducted studies and analyses within the following general task areas:

- Task I -- Aviation Data Base Development and Application
- Task II Identification of Planning Factors and Activities
- Task III -- Development of Special Issue Papers

Specific subject areas within each task were determined during frequent discussions with NASA OAST representatives. The amount of effort devoted to each subject area and, in sum, to each task was similarly determined. In this manner, ORI was able to provide flexible, quick-reaction type response on a variety of timely issues at appropriate levels of effort. Individual reports of each study and analytic effort are included in subsequent sections of Volumes I and III of this report.

ORGANIZATION OF THIS REPORT

The various studies and analyses completed by ORI were for the most part independent efforts, however, they are related in that they are supportive of NASA OAST R&T planning and evaluation efforts.

Volume I contains memorandums and papers generated under Task I. Documents developed under Tasks II and III are contained in Volumes II and III respectively. In some instances, the choice regarding insertion of documents under Task II or Task III was arbitrary.

MEMORANDUM

TO: R. Rollins
FROM: L. Kaplan and M. McDermott
SUBJECT: Aviation Data Base Development and Application - Progress Report
DATE: May 26, 1976

This memorandum discusses ORI progress in regard to Task 1: Aviation Data Base Development and Application, of the study entitled "Aviation and Programmatic Analyses". Topics covered include:

- A general discussion of the data base and what we have learned to date;
- Procedural guide for basic data tabulations, updates and entries;
- Application of the data base and computer programs to the agricultural aviation study in order to assess its value for actual utility in the OAST working environment;
- Direction of study and next steps.

GENERAL NOTES ON DATA BASE AND PROGRESS TO DATE

The Aviation Data Base used in conjunction with the General Electric Management Analysis and Projection (GEMAP) Service provides both useful data and analytic capabilities to perform simple and complex economic analyses. The system capabilities include tabulation, plotting and graphing time series, autocorrelation, correlation, curve fitting, percent change and regression analysis. These analytical capabilities hold promise as valuable tools for planning, forecasting and evaluating programs.

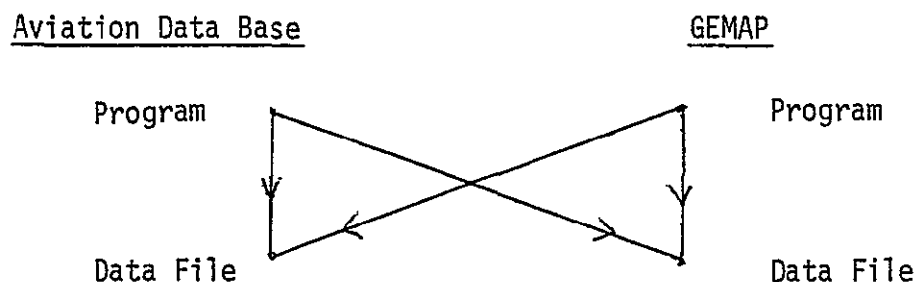
There is, however, a definite need to walk before attempting to run. At present, although there is considerable information immediately available in the Aviation Data Base, few people know how to retrieve it through the computer terminals. Moreover, as NASA planners accumulate data on subjects not presently included in the data base; that data could be placed in permanent storage in the data base file where it would be available for their own use as well as for use by others.

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Publications are available which list and describe the procedures for retrieving or adding information to the data base file and for various analytic operations. Problems stem from the fact that, for persons unfamiliar with computer systems, the process of locating appropriate sections of the publications, reading and understanding the prescribed procedures, and actually executing the procedures at a terminal, consumes far too much time. As a result, to a planner it would not appear to be worth the effort. This problem can be solved through the use of a simplified set of instructions which will enable planners to retrieve or add data within acceptable amounts of time. Examples of such instructions are presented in subsequent sections of this memorandum.

Before proceeding with more detailed discussion of ORI progress to date, some additional notes regarding the system in general are appropriate.

The Aviation Data Base and the GEMAP system may be thought of as two systems. Each system has its own data base (in the GEMAP system the data base includes seven different data banks) and its own programs. The Aviation Data Base is small in comparison, containing four data banks, with each bank having a smaller number of variables than the GEMAP banks, and can be accessed and updated with somewhat simplified programs written expressly for the aviation data base. Operations can be performed on the data in either data base through either program as indicated below:



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While the programs are similar in most respects, there are some differences which should be pointed out:

- The Aviation Data Base programs provide shortcuts and are, quite possibly, easier to learn;
- The Aviation Data Base program prints the names of variables (Ex: "Revenue Passenger Miles") in addition to the variable labels (Ex: GPBF58). The GEMAP program prints labels only. Neither program prints the type of units.
- The Aviation Data Base update program can only be used to enter annual data; for semi-annual, quarterly, monthly, etc. data, the GEMAP program must be used. This problem may not, however, effect the usefulness of the Aviation Data Base update program to NASA planners since annual data is most frequently used in evaluating government programs.
- When entering data in the aviation data base file, years for which data is not available must still be assigned a figure. A "zero" may be used but all graphic print-outs will then display a curve dropping to zero for that year. A figure from the previous year(s) may be used or figures may be interpolated from available data. A better method may be found which would enable the aviation data base program to print "NA" for data which is not available instead of zero, a previous figure or an interpolated figure.
- The Aviation Data Base update program prints out a complete description of each new variable entered into the data base which is useful as a reference index for determining the source, time span, type and frequency of the data for each variable. The GEMAP program does not provide all of this information, nor does General Electric provide a reference index to find the information.

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PROCEDURAL GUIDE

The information presented in this section enables a user with little or no computer orientation to perform tasks with the General Electric Management and Analysis Projection Service (GEMAP) and NASA's Aviation Data Base. The operations presented in this guide are by no means inclusive of all the operations possible with GEMAP, however, they do include the most useful procedures and operations for analysis and evaluation of NASA OAST programs. The guide is presented in tabular format with each table describing one operation or procedure. For example, Table 4 presents the procedure for accessing data from the system in time series format and then for plotting and graphing that data. Each table is formatted so that the user will know exactly what to type into the system and the resulting computer response. This is done by presenting two columns in each table. The first column, entitled "User Input" will be typed on the keyboard by the user, while the second column entitled "Computer Response" presents the computer's response to that input. Each procedural table is followed by an annotated hard copy example run on the terminal.

All upper case letters should be typed on the keyboard while all lower case letters describe a general command which should not be typed. For example, in Table 6, the user opens the data bank by inputting "FNA (a four letter designator for one of the data banks in Table 1)". The user types "FNAECDF" which opens the data bank ECDF and enables the user to access data from that bank. The six data banks are contained in Table 1. Variables located in a data bank are usually identifiable by the first two letters of the variable name. For example, variable POGA0013 is located in the PODF data bank. In the hard copy examples all symbols enclosed by squares are typed by the user while symbols which are not enclosed are the computer's response.

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TABLE 1
DATA BANKS

NASA Data Banks:

ECDF	SPDF
PODF	RGDF

Main data bases on GE Timesharing System (2 of 7 available)

NBERG
NBERI

Variable names located in the aviation data base are presented in Appendix A.

Various symbols and phrases used in the guide are defined in Table 2. Tables 3 through 8 provide instructions to the user for various operations and procedures which can be performed on the system.

TABLE 2
DEFINITIONS OF SYMBOLS

▲	=	space
yy	=	last two digits of data year
(cr)	=	push carriage return
no response	=	computer does not respond and user should continue with next input command
TS	=	time span
&(cr)	=	allows user to continue input on next line

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TABLE 3
SIGN - ON PROCEDURE

This procedure must be performed to begin operation of the system. The machines should be turned on and set at half full on 300 baud. The telephone is then placed on the acoustic coupler and the following number is dialed by the user:

9-340-4800

<u>User Input</u>	<u>Computer Response</u>
H (cr)	U#
HCQ01752, NASAMAP, Password (cr)	SYSTEM
FIV (cr)	NEW OR OLD

HARD COPY EXAMPLE

```
H
U#-HCQ01752,NASAMAP,ORI
SYSTEM-FIV
NEW OR OLD-
```

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TABLE 4
TABULATING, PLOTTING AND GRAPHING

<u>User Input</u>	<u>Computer Response</u>
RUN ▲ MAP (cr)	EXEC
LOGF (cr)	YOUR NEW MAP LOG FILE IS MAP LOG
	- - ?
FN▲ data bank (cr)	?
TS▲ begin yy▲ end yy▲:▲begin yy▲ end yy (cr)	?
(Note: the years for which data is desired must be listed twice)	
TAB▲ variable name (cr)	prints variable values by year.
GPLT▲Variable name(s)▲NAME*▲AIRNAMES▲. & (cr)	plots and graphs variable(s)
:▲φ▲φ▲:▲YES▲YES▲this is a title (cr)	

HARD COPY EXAMPLE

RUN MAP

MAP 11:10EST 06/03/76

FOR LATEST INFO (205 76/05/13), TYPE 'INFO' AFTER 'EXEC?'

EXEC?**LOGF**

YOUR NEW MAPLOG FILE IS MAPLOG48

?FN ECDF

?TS 60 75 : 60 75

?TAB ECGA0025

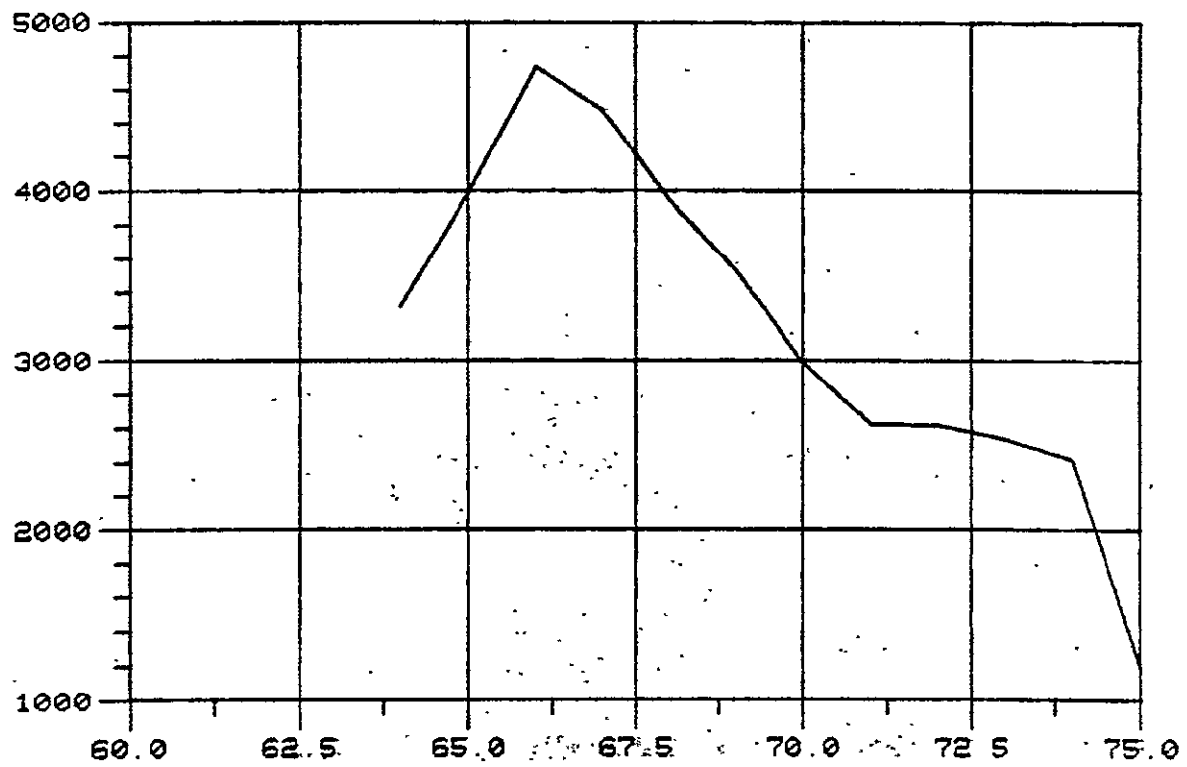
ECGA0025 ECDF 750408 17:42GMT

56					-NA-
61	-NA-	-NA-	-NA-	3317.0	3984.0
66	4741.0	4487.0	3946.0	3530.0	2991.0
71	2630.0	2623.0	2541.0	2421.0	1191.0

?GPLT ECGA0025 NAMEX AIRNAMES : 0 0 : YES YES OAST OP PLAN

OAST OP PLAN

— NASA OAST TOTAL OP PLAN



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TABLE 5
CHANGING THE EXISTING VALUE(S) OF VARIABLES
AND ADDING NEW VALUES FOR UPDATING PURPOSES

Perform the following operations after tabulation: of the variable
in question.

<u>User Input</u>	<u>Computer Response</u>
TS▲begin yy▲ end yy▲: ▲begin yy▲ end yy (cr). (Note: years are repeated)	?
NEW D▲ variable name ▲ new values (cr)	prints out first new values, then old values.

HARD COPY EXAMPLE

FN RGDF

?TS 70 80

?TAB RGOS7777

RGOS7777 RGDF 760519 15 23GMT

66					20.0
71	21.0	24.9	21.0	6.9	4.8
76	9.0	-NA-	-NA-	-NA-	-NA-
81	-NA-	-NA-	-NA-	-NA-	-NA-

?TS 76 77 76 77

?NEWD RGOS7777 8 12.7

EDITING MAP FILE RGDF

76	77		
RGOS7777	8.0	12.7	
"	9.0	-NA-	

?TAB RGOS7777

RGOS7777 RGDF 760603 16 33GMT

76	8.0	12.7
----	-----	------

?

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TABLE 6
ADDING NEW VARIABLES TO THE AVIATION
DATA BASE (FOR USE WITH ANNUAL DATA ONLY)

<u>User Input</u>	<u>Computer Response</u>
RUN ▲ UPDAT.VDF (cr)	CMf run started. (Com- puter prints number of self explanatory instruc- tions and information about the program). IS THIS A NORMAL RUN (Y/N)?
Y (cr)	More instructions and instruction ENTER VARIABLE NAME?
Variable name (cr)	ENTER TYPE (1)?
Unit of measure (i.e., MILLIONS) (cr)	ENTER LONG NAME(S)?
Enter long name of variable* (cr)	SOURCE (3)?
*Note: If description is too long for line, enter an @ for last space and return. The computer will respond with CONTINUE? and user will input the remainder.	
<u>User Input</u>	<u>Computer Response</u>
Source of data* (i.e., publication) (cr)	LOCATION (4)?
Data bank in which variable will be located (cr)	ENTER ENTRY DATE YYMMDD (5)?
Todays date - year month day (cr)	UPDATE (6)
Period of update (i.e., annual) (cr)	KEYWORD (7)?
Enter a keyword until all are entered then end with a (cr)	DESCRIPTION (8) ?
Description of the variable* (cr)	SHORTNAME (9)?
Short name (cr)	YOUR NAME
Users last name (cr)	IS THE INPUT CORRECT (YES/NO)?

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TABLE 6 (Cont)

<u>User Input</u>		<u>Computer Response</u>
<u>User Choices (2)</u>		
NO	(cr)	Instructions for editing the data.
YES	(cr)	ENTER TIME SPAN FOR VARIABLE (BEGIN YY, END YY)?
YY, YY	(cr)	ENTER DATA BASE FOR VARIABLE variable OR (cr) FOR NOT DATA?
Data bank	(cr)	ENTER VALUES FOR TIME SPAN YY THRU YY?
Numeric values for each year separated by spaces. (cr)		ENTER NEW VARIABLE NAME OR (cr), FULL OR STOP
<u>User Choices (4)</u>		
Variable name (cr)		Enters edit program allowing corrections to be made.
Full (cr)		Starts program over again for addition of a new variable
<u>User Input</u>		
STOP This command should be executed if all input is correct and no additional new variables are to be entered (cr)		Terminates this program preventing entrance of other new variables into the data base and begins the next program. Is this a Normal Run (Y/N)?
Y		IF ADDVDF IS TO BE VERIFIED (CR) OR IF NOT USE BREAK KEY?
(cr)		IS THIS RECORD TO BE DELETED (YES) OR JUST REWROTE (REW) OR ELSE (CR).
<u>User Choices (3)</u>		
YES		Record is deleted
(cr)		Instructions for editing data
REW (cr) This command should be executed if all input is correct.		Record is written. Whenever the computer responds with the question "IS THIS A NORMAL RUN (Y/N)" the user will type "Y". Further information is given and various programs are run (without user input) which enter the new variables into permanent storage in the aviation data base.

HARD COPY EXAMPLE

H
U#=HCQ01752.NASAMAP.ORI
SYSTEM- FIU
NEW OR OLD-
RUN UPDAT.UDF

UPDAT.UD 09:22EST 06/08/76.

CMF run started
RUN SAFEUDF

SAFEUDF 09:23EST 06/08/76.

***** RUN THIS PROGRAM ONLY ON 300 BAUD CONNECTION *****

IF NOT YOU WILL BE UNABLE TO INPUT DATA
END RUN BY HITTING BREAK KEY TILL RUN ENDS
THEN DAIL 300 BAUD NUMBER

THE PURPOSE OF THIS SYSTEM IS TO PROVIDE AN EASY METHOD
OF UPDATING THE UDF AND AIRNAMES FILES AFTER NEW VARIABLES
HAVE BEEN ADDED TO THE MAP DATA FILES. BECAUSE OF THE MANNER
IN WHICH THE SYSTEM RUNS THE PROGRAM, THERE IS THE
POSSIBILITY OF A SYSTEM INTERRUPT OR BREAK WHEN NOT NEEDED
DURING EXECUTION. SOME SAFEGUARDS HAVE BEEN PUT
INTO THE SYSTEM TO SAVE WHAT HAS BEEN DONE.

- 1 - IF THE SYSTEM INTURRUPTES WHAT HAS BEEN DONE IS NOT LOST
- 2 - THE UPDAT.UDF CAN BE RESTARTED AT CERTAIN LOCATIONS.
- 3 - PROTECTION TO THE UDF FILE AND AIRNAMES FILE IS ADDED
AGAINST THE POSIABLITY OF DESTRUCTION.

YOU WILL ONLY NEED TO RUN THESE SAFEGUARD PROGRAMS IF THERE
HAS BEEN AN ERROR. IF THE HAS BEEN AN ERROR RESPOND TO THE
QUESTION IS THERE AN ERROR.

WHEN READY TO CONTINUE ENTER A (CR)?

IS THIS A NORMAL RUN (Y/N) Y

PROGRAM STOP AT 270

USED 2.37 UNITS

CRE AIRTMP11.,

READY

CRE ADDUDFT.,

DUPLICATE FILE NAME.

READY

*** COMMAND MALFUNCTION-SKIPPING TO \$BREAK ***

\$BREAK

ENTER VARIABLE NAME? FOGA1111
ENTER TYPE(1)? MILLIONS
ENTER LONG NAME (2)? ACRES TREATED BY AGRICULTURAL AIRCRAFT
ENTER SOURCE (3)? AVIATION 1974
ENTER LOCATION (4)? PODF
ENTER ENTRY DATE YYMMDD(5)? 760523
ENTER FREQ OF UPDATE (6)? ANNUALLY
ENTER KEYWORD(7)? AG-AIR
ENTER KEYWORD(7)?
ENTER DESCRIPTION (8)? MILLIONS OF ACRES OF FARMLAND TREATED BY AGRICULTURAL AIRCRAFT
ENTER SHORT NAME (9)? AG-AIR ACRES
ENTER YOUR LAST NAME? KAPLAN
IS THE INPUT CORRECT (YES/NO)? YES

PRECEDING PAGE BLANK NOT FILMED

ENTER TIME SPAN FOR POGA1111 (BEGIN YY, END YY) 67 72

ENTER DATA BASE FOR VARIABLE POGA1111 OR (CR) FOR NO DATA PDF

ENTER 6 VALUES FOR TIME SPAN 67 THRU 72
72 79 91 104 116 118

RECORD *****

POGA1111 10 @1MILLIONS 1@ @2ACRES TREATED BY AGRICULTURAL AIRCRAFT2@
POGA1111 12 @3AVIATION 19743@ @4PODF4@ @57605235@ @6ANNUALLY6@
POGA1111 14 @7AG-AIR7@ @8MILLIONS OF ACRES OF FARMLAND TREATED
POGA1111 16 BY AGRICULTURAL AIRCRAFT8@ @9AG-AIR ACRES9@ @A KAPLAN
POGA1111 18 A@ @T 1967-72 T@
ENTER NEW VARIABLE NAME OR CR. FULL. OR STOP? SP.TOP

IS THIS A NORMAL RUN (Y/N) ☒ Y

PROGRAM STOP AT 270

USED 2 06 UNITS
RUN 0. UPVDF4

IF ADDVDF IS TO BE VERIFIED (CR), IF NOT USE BREAK KEY?

*****RECORD READ*****

POGA1111 @1MILLIONS 1@ @2ACRES TREATED BY AGRICULTURAL AI
POGA1111 RCRAFT2@ @3AVIATION 19743@ @4PODF4@ @57605235@ @6
POGA1111 ANNUALLY6@ @7AG-AIR7@ @8MILLIONS OF ACRES OF FARM
POGA1111 LAND TREATED BY AGRICULTURAL AIRCRAFT8@ @9AG-AIR
POGA1111 ACRES9@ @A KAPLAN A@ @T 1967-72 T@
IS THIS RECORD TO BE DELETED (DEL) OR REWROTE (REW)
ELSE (EDI) TO EDIT INPUT REW

*****WRITE RECORD*****

POGA1111 10 @1MILLIONS 1@ @2ACRES TREATED BY AGRICULTURAL AIRCRAFT2@
POGA1111 12 @3AVIATION 19743@ @4PODF4@ @57605235@ @6ANNUALLY6@
POGA1111 14 @7AG-AIR7@ @8MILLIONS OF ACRES OF FARMLAND TREATED
POGA1111 16 BY AGRICULTURAL AIRCRAFT8@ @9AG-AIR ACRES9@ @A KAPLAN
POGA1111 18 A@ @T 1967-72 T@

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

IS THIS A NORMAL RUN (Y/N) ☒ Y

PROGRAM STOP AT 260

USED 3.69 UNITS
OLD ADDUDF

READY
EDI SEQ

READY
REP

READY
RUN 0. UPVDF2

0. UPVDF2 09:45EST 06/08/76

**** THIS IS AN UPDATE LISTING TO THE VDF FILE ****
IS THE OUTPUT TO BE HARDCOPIED (YES/NO) ☒ YES

CURRENT DATE: 06/08/76

VARIABLE NAME: POGA1111

FILE LOCATION: PODF TYPE: MILLIONS

LONG NAME: ACRES TREATED BY AGRICULTURAL AIRCRAFT

SOURCE: AVIATION 1974

DATE: 760523 FREQ: ANNUALLY TIME SPAN: 1967-72

KEYWORDS: AG-AIR

DESCRIPTION: MILLIONS OF ACRES OF FARMLAND TREATED BY AGRICULTURAL
AIRCRAFT

SHORT NAME: AG-AIR ACRES

IS THIS A NORMAL RUN (Y/N)? ☒

PROGRAM STOP AT 270

USED 256 UNITS
RUN 0. UPVDF3

0. UPVDF3 09:48EST 06/08/76

**** THIS IS AN UPDATE TO THE AIRNAMES FILE OF LONG NAMES ****
DO YOU WANT A HARDCOPY MADE (YES/NO)? ☒

POGA1111 ACRES TREATED BY AGRICULTURAL AIRCRAFT

PROGRAM STOP AT 9800

USED 19.99 UNITS
OLD AIRTMP11

READY
EDI SEQ

READY
REP

READY
EDI MER AIRNAMES, AIRTMP11

READY
REP

READY
\$BREAK
PUR ADDUDFT

READY
end of cmf run
READY

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TABLE 7
ADDING NEW VARIABLES USING GEMAP PROGRAM

This program should be used when data values are for intermittent years, whereas the previous aviation data base program (RUN UPDATE.VDF) is used when data values are for continuous years.

<u>User Input</u>	<u>Computer Response</u>
RUN▲MAP (cr)	?
NEWV▲Variable name (cr)	?
TS▲begin yy▲ end yy▲: ▲begin yy▲ end yy (cr)	?
NEWDAVariable name ▲ Data Value for first year (cr)	EDITING MAP FILE (computer will print data in following format:) Data Bank
	Year Year Variable name Value ?
ALTD ▲ Variable name ▲ next year (cr) (YY) in which data is available ▲ ▲Data value for next year in which data is available	(Computer will print data in following format:) Year Year Variable name Value ?
Continued with "ALTD" etc. until (cr) all data is entered	

HARD COPY EXAMPLE

HHHH
U#-HCQ01752,NASAMAP,ORI
SYSTEM- FIU
NEW OR OLD-
RUN MAP

MAP 08:48EST 06/08/76

FOR LATEST INFO (207 76/06/07), TYPE 'INFO' AFTER 'EXEC?'

EXEC?LOGF

YOUR NEW MAPLOG FILE IS MAPLOG48
NEWU POGA0034

MAP FILE NAME?PODF

TS 75 99 : 75 99

NEWU POGA0034 6 8

EDITING MAP FILE: PODF

ALTD POGA0034 80 10 2

EDITING MAP FILE PODF

80 80
POGA0034 10 2
" -NA-

ALTD POGA0034 35 34

EDITING MAP FILE PODF

85 85
POGA0034 34 0
" -NA-

ALTD POGA0034 90 68

90 90
POGA0034 68.0
" -NA-

ALTD POGA0034 95 115.6

95 95
POGA0034 115.6
" -NA-

ALTD POGA0034 99 153

99 99
POGA0034 153.0
" -NA-

TAB POGA0034

POGA0034: PODF 760608 13:57GMT

71					6 8
76	-NA-	-NA-	-NA-	-NA-	10.2
81	-NA-	-NA-	-NA-	-NA-	34.0
86	-NA-	-NA-	-NA-	-NA-	68.0
91	-NA-	-NA-	-NA-	-NA-	115 6
96	-NA-	-NA-	-NA-		153.0

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TABLE 8
SIGN-OFF PROCEDURE

<u>User Input</u>	<u>Computer Response</u>
BYE or GOODBYE	Run is terminated

HARD COPY EXAMPLE

BYE
00153.24 CRU 0000.77 TCH 0006.29 KC
OFF AT 11.44EST 06/03/76

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DATA BASE UTILITY FOR NEW PROGRAMS

The Ag-Air program has been chosen as a potential example around which a workshop session could be developed. The discussion will also illustrate some of the problems associated with using the data base for real problems in real time. An additional example is being developed relating to total aeronautics sales (world-wide), past and future. We believe that the ultimate utility of this system can be determined by reviewing the deficiencies of the current system as applied to day-to-day problems facing OAST.

There is another consideration regarding the two systems which should be discussed. The information in the GEMAP data files is voluminous and is inserted and updated by other sources. The data in the Aviation Data Base files has been collected by ORI because of its potential applicability to NASA programs. It is not currently being updated but can be updated when its utility has been established. The usefulness of various data is somewhat difficult to predict. At the time when the data base was developed, average farm size in the United States probably received little or no consideration as a variable worth storing in the data file. Yet, in the on-going agricultural aviation study, just such a statistic proved useful. This and other data become useful after the fact. In such cases, it would still be useful to enter such data in the aviation data base file for monitoring purposes as programs continue into the out years. There will no doubt be other programs which require collection of data not presently found in the aviation data base file. But this does not mean that the file is useless; it merely indicates that such data should be added to the file for continued use. In the meantime, agricultural aviation program data, general aviation data, high technology assessment data and other data collected for use in on-going programmatic analyses could be entered into the data file.

Variables presently contained in the aviation data base which were useful in planning and evaluating the agricultural aviation program are listed in Table 9.

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TABLE 9. AVIATION DATA BASE VARIABLES
RELEVANT TO AG-AIR STUDY

Gross National Product (GNP)
Farm Business GNP
Real Farm Business GNP
Agricultural Employment
Farm Residential Structures
Accidents Per 100 Million Miles
Rates of Return
Farm Proprietors Income

Figures 1 and 2 demonstrate the plotting and graphing capabilities of the GEMAP System. Figure 1 displays GNP and Farm Business GNP, providing useful data as well as illustrating the relationship between the two indicators. Figure 2 illustrates the cyclical yet overall upward trend of Real Farm Business GNP. Figures 3 through 7 display other variables listed in Table 9.

A significant quantity of other data pertaining to agricultural aviation was collected from various sources. Such data could be added to the aviation data base and thus be made readily available for use in future economic and cost/benefit analyses. As NASA planners become familiar with computer terminal procedures, they may also be able to make use of the more complex analytic capabilities of the GEMAP system.

Table 10 provides a list of additional variables which could be entered into the data base for continued use in support of the ag-air program.

TABLE 10. ADDITIONAL VARIABLES RELEVANT TO
AG-AIR STUDY

UNITED STATES STATISTICS

Miles flown by Ag-Aircraft
Hours flown by Ag-Aircraft
Number of Ag-Air operators
Number of Ag-Aircraft
Number of Ag-Air pilots
Acres treated by Ag-Aircraft
Gallons of fuel used by Ag-Aircraft
Accidents involving Ag-Aircraft
Fatalities from Ag-Air accidents
Acres in cultivation

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WORLD STATISTICS

Number of Ag-Aircraft
Acres treated by Ag-Aircraft
Acres in cultivation

No-Till Farming Trends

In the course of the ag-air study, new farming techniques were examined to determine their potential impact on the use of ag-aircraft. No-till farming (a technique wherein crops are directly planted without prior plowing or seedbed preparation in a sod or the residue of a preceding crop) was identified as a technique having broad implications for ag-air.

Data collected for use in estimating the impact of no-till trends on ag-air was not available in the aviation data base files. However, such data provides an excellent example of the type of information which can be added to the data base and made available for future use. ORI entered relevant data into the aviation data base files where it can now be accessed as required. Examples of data entered include:

- Total acres treated by ag-air (Figure 8).
- Projected acres farmed by no-till methods (Figure 9).
- Projected acres treated by ag-aircraft (Figure 10).

Figure 8 totals for acres treated by ag-aircraft reflect multiple applications.

In Figure 10, the data point for 1974 indicates 200 million acres (multiple applications) were treated by ag-aircraft. Data for subsequent years include a constant total of 200 million acres for existing ag-air operations plus the additional acres resulting from projected increases in no-till techniques. No-till totals are calculated at the rate of one additional application per acre. In reality, the number of acres treated by ag-air, exclusive of no-till trends, can be expected to increase at some as yet undetermined rate. By the same token, the projected increases in no-till acreage will include some number of acres presently being cultivated by standard techniques and which are already being treated by ag-air. The analysis is therefore incomplete and will require indepth study to develop more realistic projections. Determinations will be required relating to:

GROSS NATIONAL PRODUCT

— GROSS NATIONAL PRODUCT
--- FARM BUSINESS GNP, PRIVATE, GNP BY SECTOR

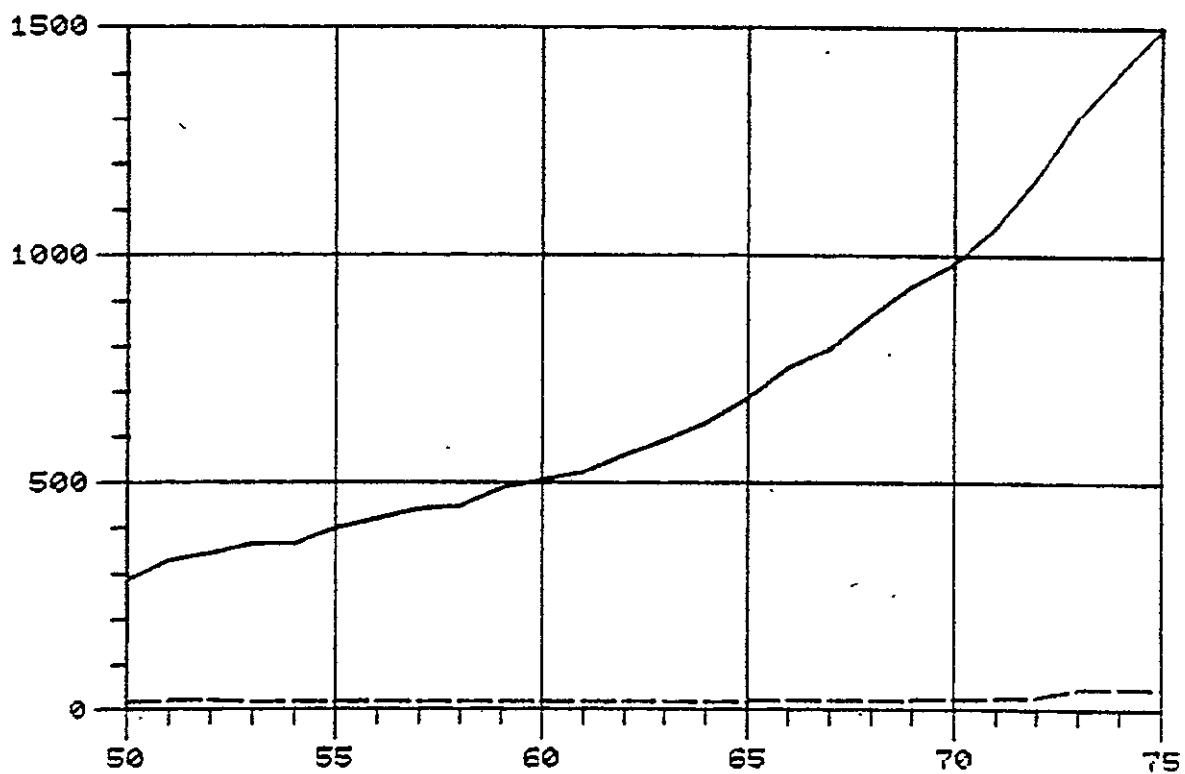


FIGURE 1

REAL FARM BUSINESS GNP

— REAL FARM BUSINESS GNP 1958, PRIVATE, GNP58 BY

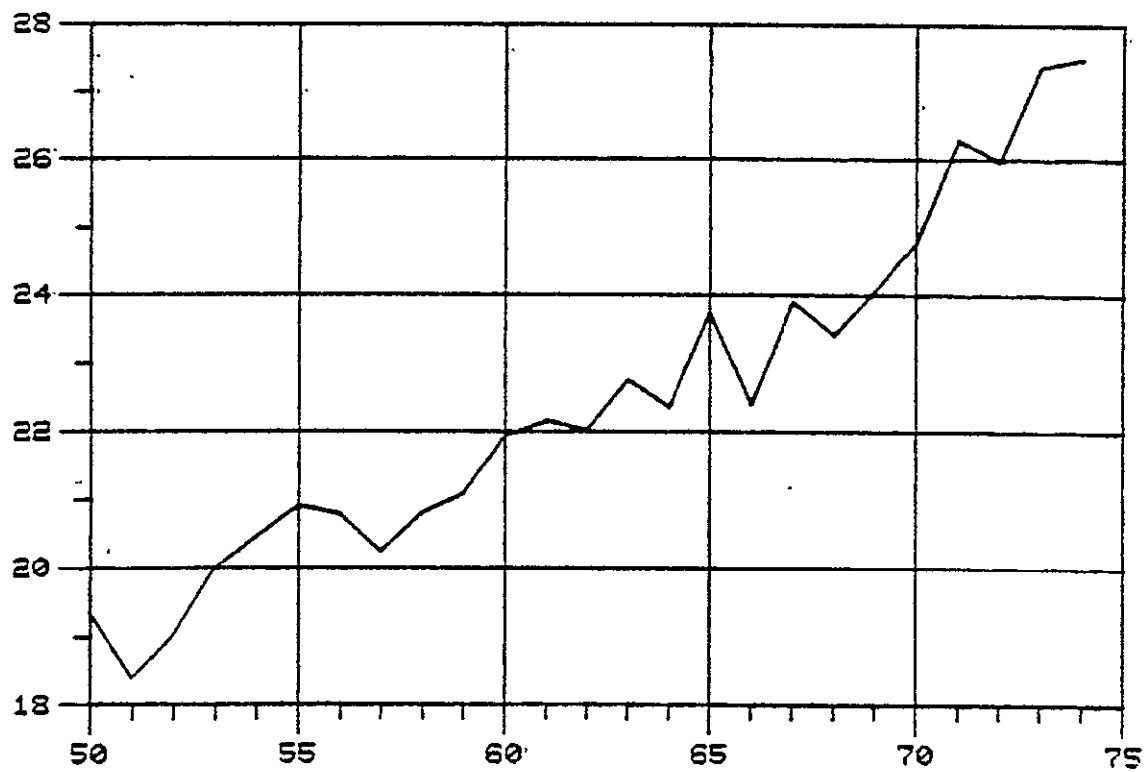


FIGURE 2
38

AGRICULTURE EMPLOYMENT

____ AGRICULTURAL EMPLOYMENT, CFL.

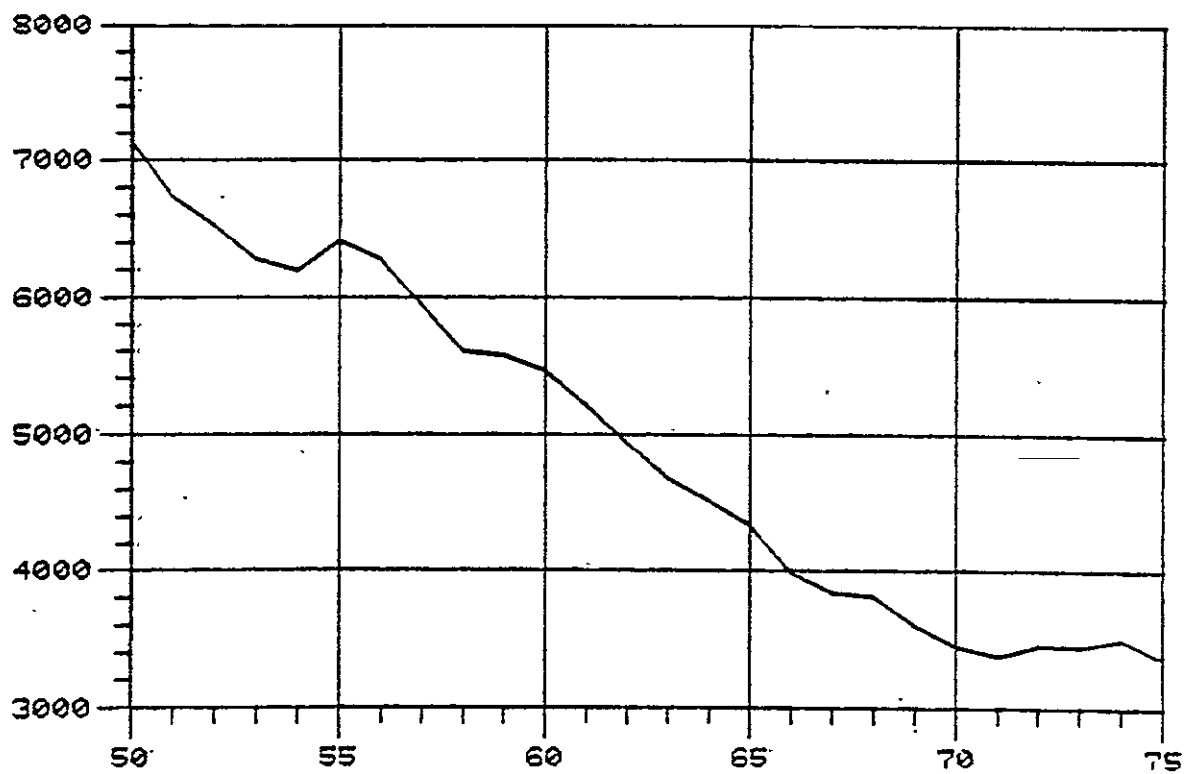


FIGURE 3

FARM RESIDENTIAL STRUCTURES

— FARM RESIDENTIAL STRUCTURES, PDI

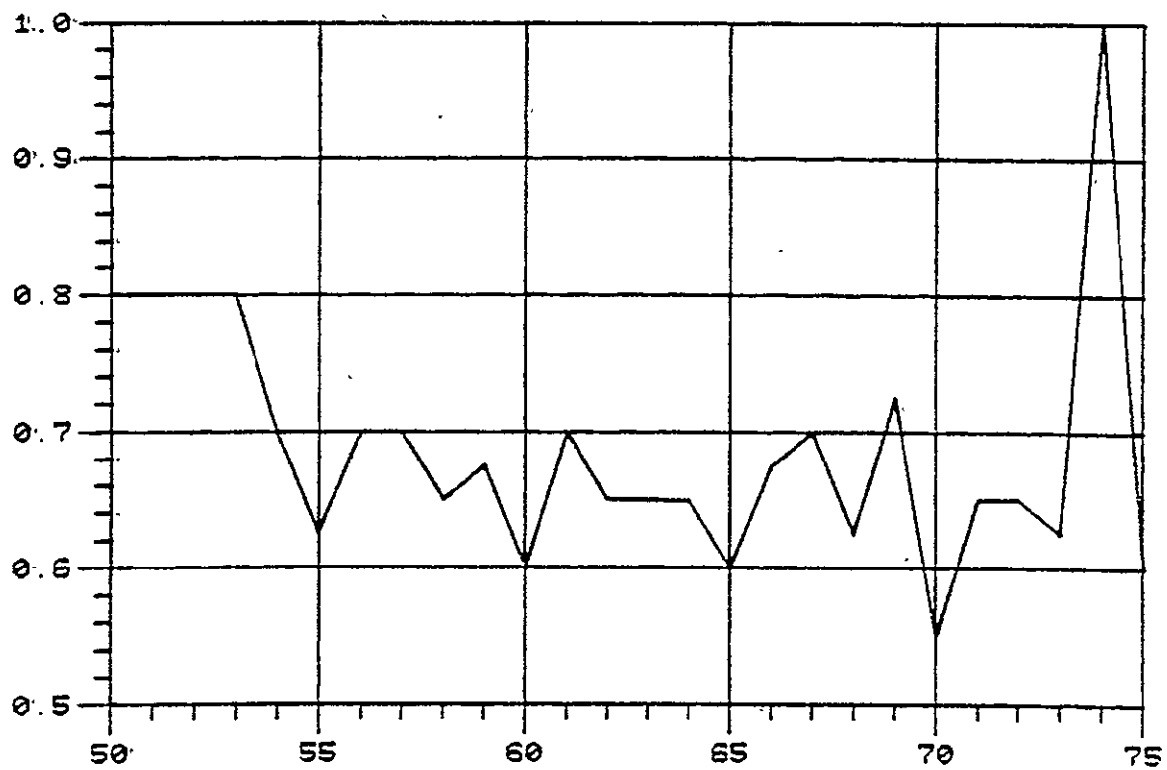


FIGURE 4
40

ACCIDENTS

— ACCIDENTS PER 100 MILLION MILES
- - - PASSENGER FATALITIES PER 100 MILLION PASSENGER M

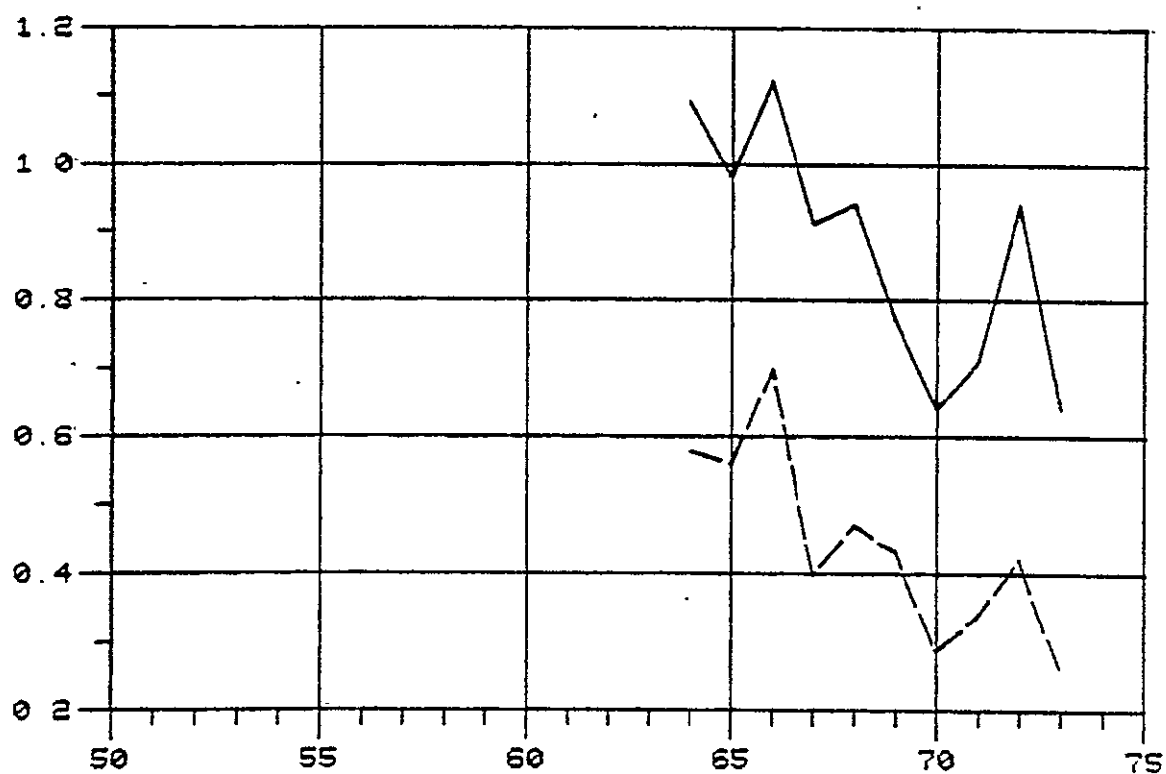


FIGURE 5

AIRLINE INDUSTRY RATE OF RETURN ON INVESTMENT

RATE OF RETURN

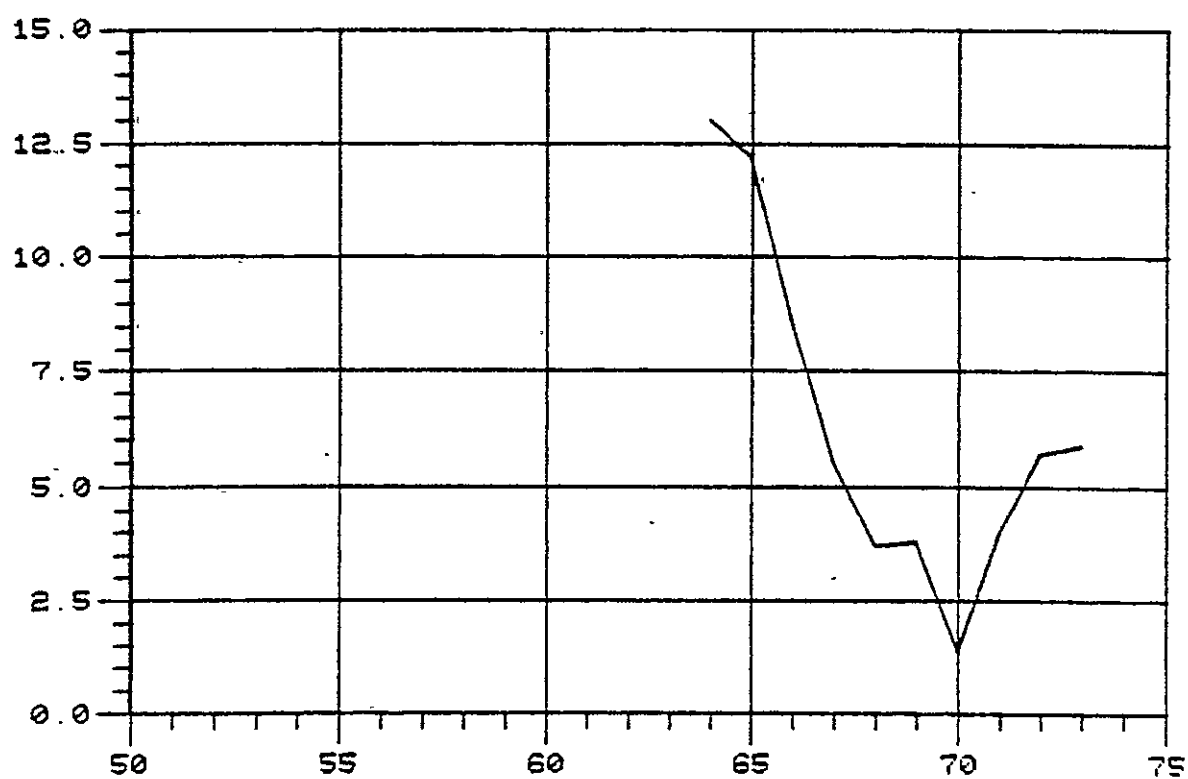


FIGURE 6

FARM PROPRIETORS INCOME

FARM PROPRIETORS INCOME GY.

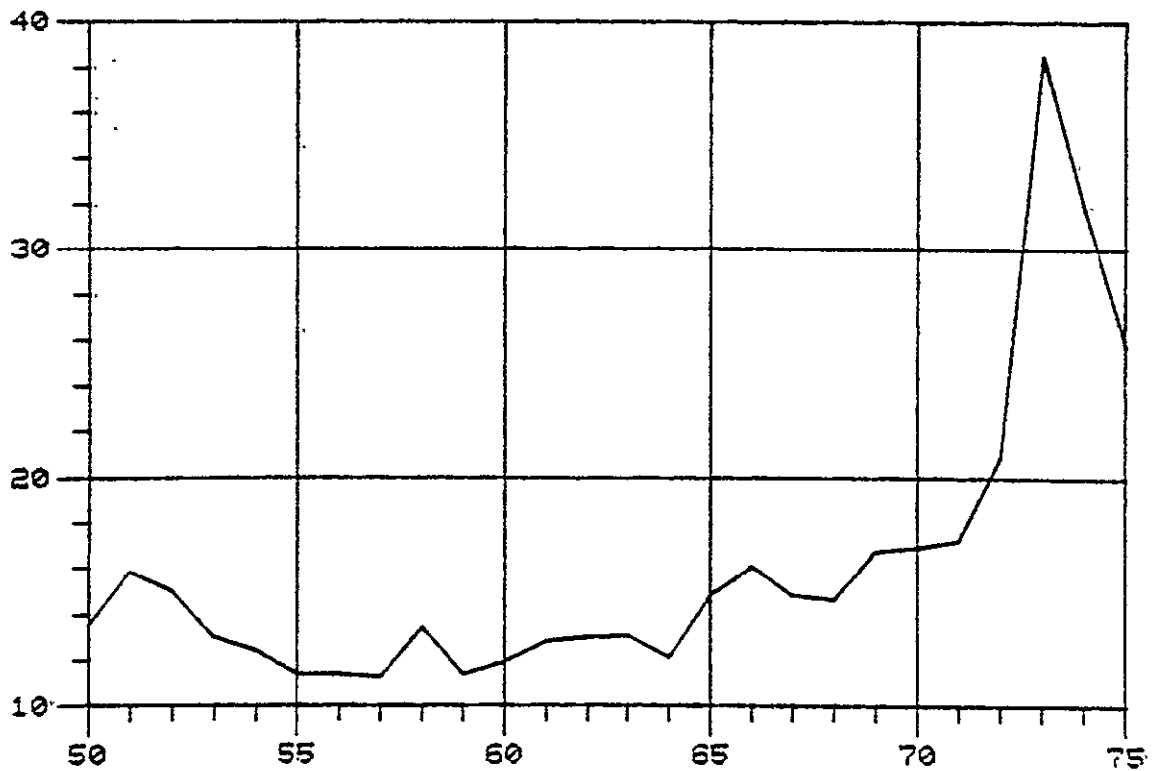


FIGURE 7

ACRES TREATED BY AG-AIR

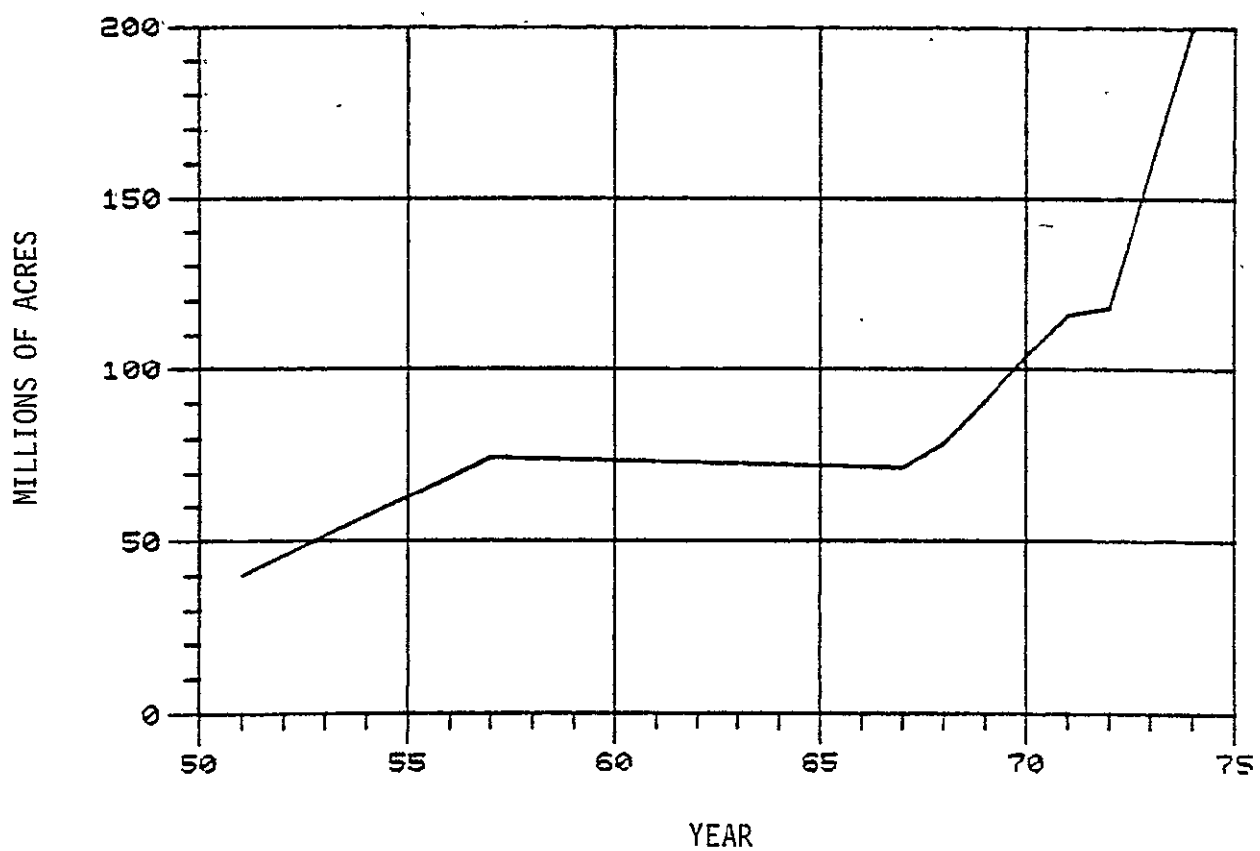


FIGURE 8

PROJECTED ACRES NO-TILL FARMED

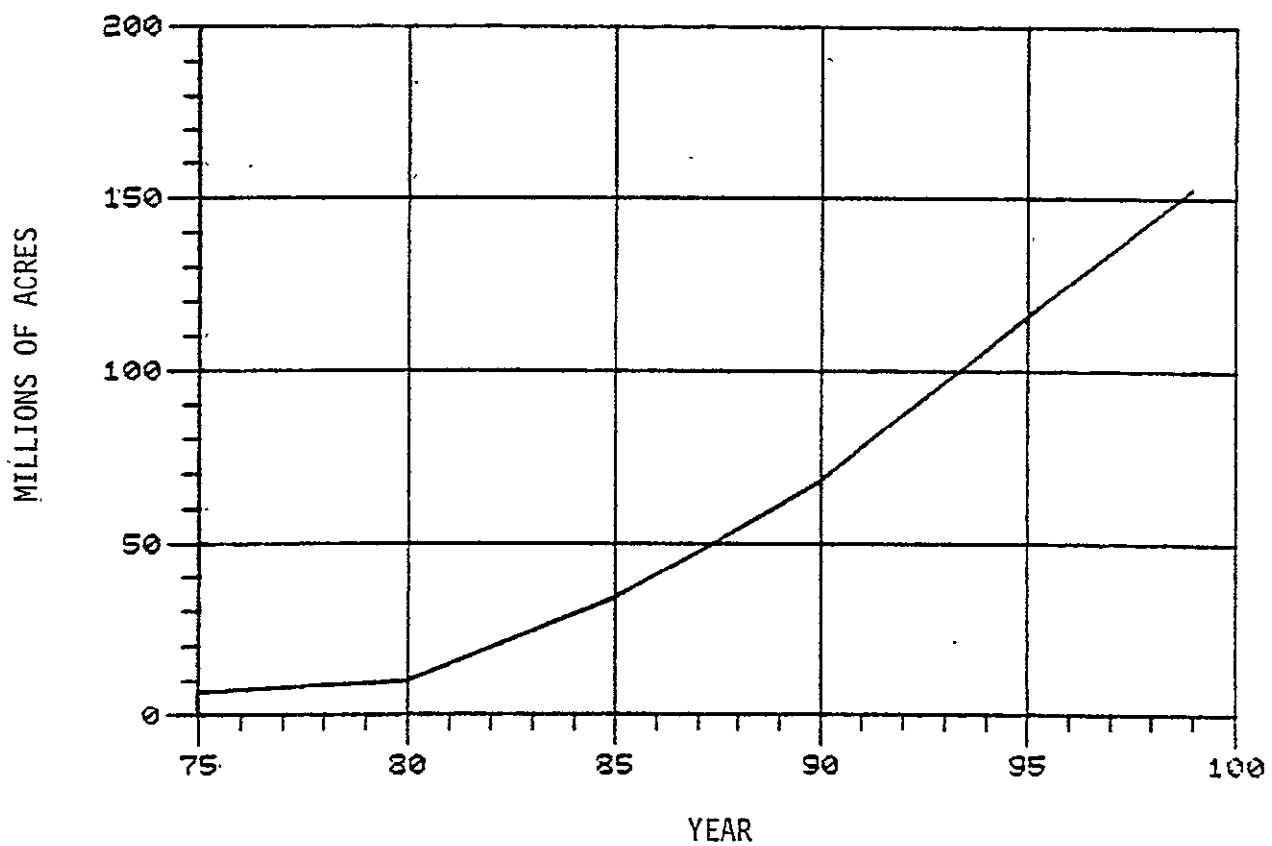


FIGURE 9
-45-

PROJECTED ACRES TREATED BY AGRICULTURAL AIRCRAFT

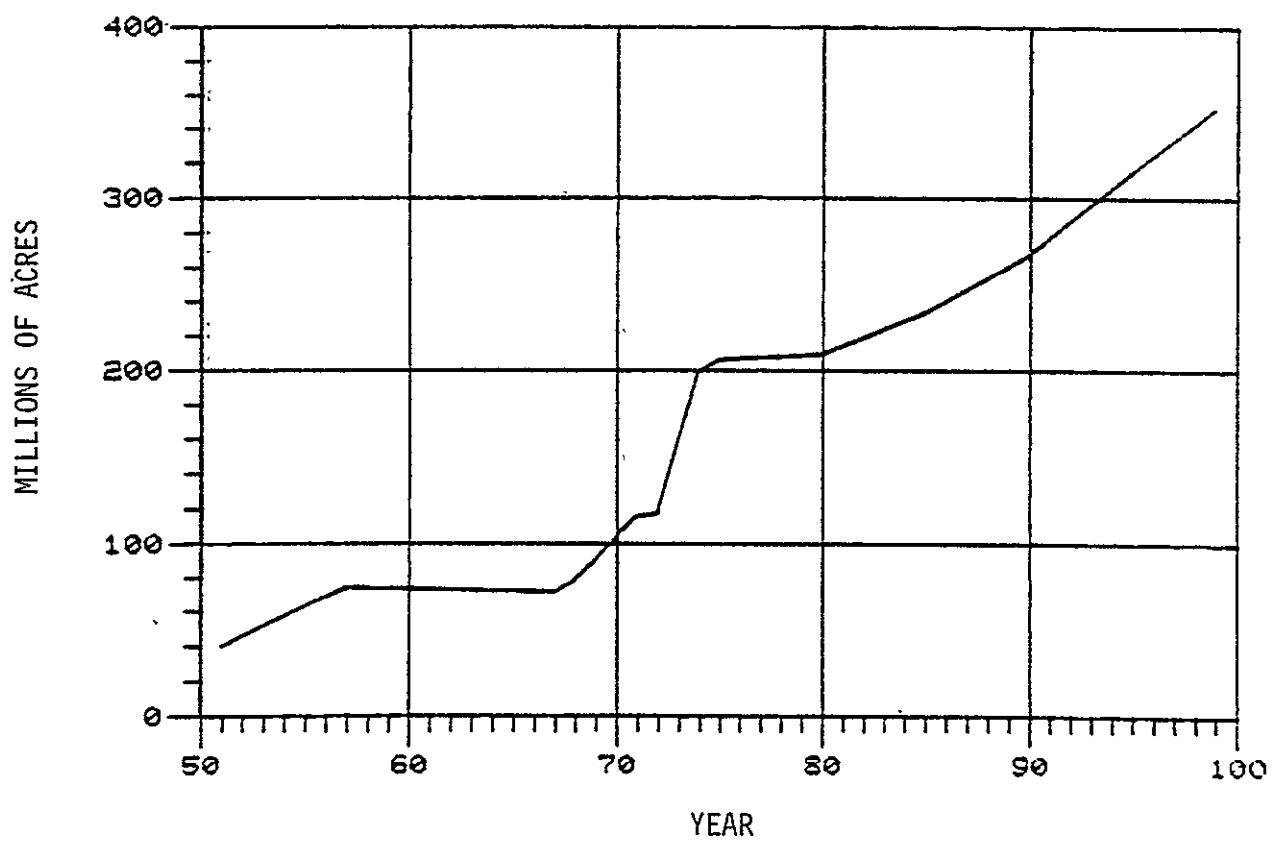


FIGURE 10

Subj: Aviation Data Base Development and Application - Progress Report

- The rate of increase of total acres treated by ag-air exclusive of no-till trends (analysis would involve identification of primary factors driving ag-air growth);
- The number of acres currently treated by ag-air and cultivated by standard means which are likely to be included in no-till programs;
- The average number of applications per acre under no-till techniques. (Considered above as one per acre but the actual number is expected to exceed this figure.)

The data tabulations depicted graphically in Figures 8, 9 and 10 can be generated through simple computer terminal procedures. The more complex analytic procedures necessary to support an in-depth analysis of the impact of no-till farming on ag-air can also be supported by the aviation data base programs. NASA planners have the option to learn the more complex procedures or to seek support in conducting the more complex analyses.

DIRECTION OF STUDY AND NEXT STEPS

The Aviation Data Base and the GEMAP system contain useful analytic information which can be accessed and displayed in time series format. They can also accept data updates as well as data for new variables not presently in the data files. Moreover, the Aviation Data Base and GEMAP programs include sub-routines which enable analysts to perform more complex socio-economic analyses.

The procedures outlined in this memorandum can provide users with sufficient information to access, enter and update data. In using these procedures, the users can also gain sufficient familiarity with the system to perform the more complex socio-economic analyses. It should be pointed out that the more complex computer sub-routines (Ex: regression analyses) involve terminal procedures no more complicated than those for accessing, entering and updating data.

Subj: Aviation Data Base Development and Application - Progress Report

ORI will continue development of user information in preparation for a series of workshops designed to enable NASA planners to utilize the Aviation Data Base and GEMAP system on a continuing basis.

Certain problem areas have already been identified by ORI and will receive continued emphasis:

- Integration of the Aviation Data Base update program with the GEMAP program so that the advantages of each may be incorporated in one procedure.
- Determination of variables which are significant and which therefore should be verified and updated.
- Determination of the type of storage (temporary or permanent) that is actually achieved when using the GEMAP system.
- Identification of the type of units which the computer is printing (Ex. thousands, millions, etc).
- Use of data base for on-going problems and description of difficulties encountered.

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AIRNAMES -12:05EST 01/15/70

100 POGA0001 RATE OF RETURN
~~110 POGA0002 REVENUE-PASSENGER MILES~~
120 POGA0003 LOAD FACTOR
~~130 POGA0004 U.S. MANUF. AIRCRAFT IN OPERATION ON WORLD CIVIL AIRLINES~~
140 SPGA0002 PILOTS AND COPILOTS EMPLOYED ON U.S. SCHEDULED AIRLINES
~~150 SPGA0003 TOTAL EMPLOYMENT OF U.S. SCHEDULED AIRLINES~~
160 SPGA0001 TOTAL U.S. AIRLINE PAYROLL
~~170 POGA0005 DOMESTIC AIRLINES AVERAGE REVENUE PER PASSENGER MILE~~
180 POGA0009 U.S. AIRLINE INTERNATIONAL AVERAGE REVENUE PER PASSENGER MILE
~~190 PURR0001 AVERAGE REVENUE PER PASSENGER MILE: RAILROADS~~
200 POGA0001 AVERAGE REVENUE PER PASSENGER MILE FOR INTERCITY MOTOR BUSES
~~210 ECGA0001 NASA INTRAMURAL RESEARCH OBLIGATIONS~~
220 ECGA0002 NASA INDUSTRY RESEARCH OBLIGATIONS
~~230 ECGA0003 NASA FFRDC RESEARCH OBLIGATIONS~~
240 ECGA0004 NASA UNIVERSITY AND COLLEGE RESEARCH OBLIGATIONS
~~250 ECGA0005 NASA FFRDC (U&C) RESEARCH OBLIGATIONS~~
260 ECGA0006 NASA OTHER NON-PROFIT RESEARCH OBLIGATIONS
~~270 ECGA0007 NASA FFRDC (OTHER NON-PROFIT) RESEARCH OBLIGATIONS~~
280 ECGA0008 NASA OTHER RESEARCH OBLIGATIONS
~~290 ECGA0009 NASA FOREIGN RESEARCH OBLIGATIONS~~
300 ECGA0010 NASA TOTAL RESEARCH OBLIGATIONS
~~310 ECGA0011 NASA INTRAMURAL DEVELOPMENT OBLIGATIONS~~
320 ECGA0012 NASA INDUSTRY DEVELOPMENT OBLIGATIONS
~~330 ECGA0013 NASA FFRDC (IND) DEVELOPMENT OBLIGATIONS~~
340 ECGA0014 NASA UNIVERSITY & COLLEGE DEVELOPMENT OBLIGATIONS
~~350 ECGA0015 NASA FFRDC (U&C) DEVELOPMENT OBLIGATIONS~~
360 ECGA0016 NASA OTHER NON-PROFIT DEVELOPMENT OBLIGATIONS
~~370 ECGA0017 NASA FFRDC (OTHER NON-PROFIT) DEVELOPMENT OBLIGATIONS~~
380 ECGA0018 NASA OTHER DEVELOPMENT OBLIGATIONS
~~390 ECGA0019 NASA FOREIGN DEVELOPMENT OBLIGATIONS~~
400 ECGA0020 NASA TOTAL DEVELOPMENT OBLIGATIONS
~~410 ECGA0021 NASA OAST AERO OP PLAN~~
420 ECGA0022 NASA OAST SPACE OP PLAN
~~430 ECGA0023 NASA OAST NUCLEAR OP PLAN~~
440 ECGA0024 NASA OAST LOW COST SYSTEMS OP PLAN
~~450 ECGA0025 NASA OAST TOTAL OP PLAN~~
460 ECGA0026 TOTAL FEDERAL AERONAUTICS R&D NOA
~~470 ECGA0027 NASA AERONAUTICS R&D NOA~~
480 ECGA0028 DOD AERONAUTICS R&D NOA
~~490 ECGA0029 DGT AERONAUTICS R&D NOA~~
500 ECGA0030 TOTAL DOD OUTLAYS FOR AIRCRAFT PROCUREMENT
~~510 ECGA0031 AIR FORCE OUTLAYS FOR AIRCRAFT PROCUREMENT~~
520 ECGA0032 NAVY OUTLAYS FOR AIRCRAFT PROCUREMENT
~~530 ECGA0033 ARMY OUTLAYS FOR AIRCRAFT PROCUREMENT~~
540 POGA0010 U.S. DOMESTIC PASSENGER MILES FLOWN
~~550 POGA0011 U.S. DOMESTIC PASSENGER SERVICE: PASSENGERS CARRIED~~
560 POGA0012 INTERNATIONAL PASSENGER MILES FLOWN
~~570 POGA0013 U.S. INTERNATIONAL AIRLINES SERVICE: PASSENGERS CARRIED~~
580 ECHR0001 HIGH-SPEED GROUND TRANSPORTATION R&D

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~~590 ECRH0002 RAILROAD RESEARCH~~
~~600 ECRH0003 TOTAL FEDERAL FUNDS: FEDERAL RAILROAD ADMINISTRATION~~
~~610 ECGA0034 FED. EXP. FOR DOMESTIC TRANSPORTATION - AIRWAYS~~
~~620 ECGA0035 FEDERAL AIRPORT GRANTS IN AID~~
~~630 SPRH0001 RAILROAD EMPLOYMENT~~
~~640 SPRH0002 ANNUAL RAILROAD PAYROLL~~
~~650 SPRH0003 ANNUAL EARNINGS PER RAILROAD EMPLOYEE~~
~~660 SPRH0004 HOURLY EARNINGS FOR RAILROAD EMPLOYEES~~
~~670 SPGA0005 AIRCRAFT INDUSTRY EMPLOYMENT~~
~~680 SPGA0004 TOTAL (DOMESTIC SCHEDULED AIR AIR CARRIERS) PERSONNEL~~
~~690 PDGA0014 AV. GASOLINE & JET FUEL CONSUMPTION~~
~~700 PDGA0015 REVENUE PASSENGER MILES~~
~~710 ECHH0001 FEDERAL HIGHWAY TRANSPORTATION EXPENDITURES~~
~~720 ECHH0002 STATE AND LOCAL HIGHWAY EXPENDITURES~~
~~730 ECHH0003 TOTAL CIVIL HIGHWAY EXPENDITURES~~
~~740 ECDS0001 FEDERAL TRANSPORTATION EXPENDITURES FOR THE COAST GUARD~~
~~750 ECDS0002 FEDERAL TRANSPORTATION EXPENDITURES FOR MERCHANT MARINES~~
~~760 ECDS0003 INLAND & INTERCOASTAL WATERWAYS - FEDERAL TRANSPORTATION EXP~~
~~770 ECDS0004 WATERWAYS - FEDERAL TRANSPORTATION EXPENDITURES~~
~~780 ECDS0005 WATERWAYS-TOTAL CIVIL TRANSPORTATION EXPENDITURES~~
~~790 ECDS0006 WATERWAYS - STATE AND LOCAL EXPENDITURES~~
~~800 ECGA0036 AIRPORT ADMINISTRATION AND RESEARCH - FEDERAL~~
~~810 ECGA0037 AIRPORT EXPENDITURES - STATE AND LOCAL~~
~~820 ECGA0038 AIRPORT EXPENDITURES - TOTAL CIVIL~~
~~830 ECGA0039 FEDERAL CASH SUBSIDY TO DOMESTIC AIRLINES~~
~~840 ECGA0040 AV. U.S. PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~850 ECFAC001 AV. CANADA PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~860 ECFAC002 AV. JAPAN PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~870 ECFAC003 AV. GERMANY PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~880 ECFAC004 AV. FRANCE PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~890 ECFAC005 AV. ITALY PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~900 ECFAC006 AV. NETHERLANDS PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~910 ECFAC007 AV. U.K. PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~920 ECFAC008 AV. OTHER PERCENTAGE SHARES OF AIRCRAFT EXPORTS~~
~~930 FCREXP FOREIGN PERCENTAGE OF AIRCRAFT EXPORTS~~
~~940 SPRH0005 AVERAGE ANNUAL SALARY - RAILWAY EMPL.~~
~~950 SPRH0001 AVERAGE ANNUAL SALARY - HIGHWAY EMPL.~~
~~960 SPRH0002 AVERAGE ANNUAL SALARY - MOTOR FREIGHT EMPL.~~
~~970 SPOS0001 AVERAGE ANNUAL SALARY - WATER EMPL.~~
~~980 SPOS0002 AVERAGE ANNUAL SALARY - AIR EMPL.~~
~~990 SPOS0003 AVERAGE ANNUAL SALARY - PIPELINE EMPL.~~
~~1000 JTH12 AVERAGE ANNUAL EARNINGS - OTHER TRANS. MODES~~
~~1010 HAY12 AVERAGE ANNUAL EARNINGS - HIGHWAY~~
~~1020 SPGA0007 AIRLINE-AVER. LABOR COST PER REVENUE TON-MILE~~
~~1030 SPGA0008 AIRLINE REVENUE TON-MILES PER EMPLOYEE~~
~~1040 SPGA0009 AVER. LABOR COST PER AIRLINE EMPLOYEE~~
~~1050 SPOS0004 AV. NO. TOTAL TRANSPORTATION SECTOR EMPLOYEES~~
~~1060 SPRH0000 AV. NO. RAILWAY EMPLOYEES~~
~~1070 SPRH0003 AV. NO. HIGHWAY PASSENGER EMPLOYEES~~

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1090 SPH0004 AV. NO. MOTOR FREIGHT EMPLOYEES
 1100 SPUS0005 AV. NO. WATER EMPLOYEES
~~1110 SPGA0010 AV. NO. AIR EMPLOYEES~~
 1120 SPUS0006 AV. NO. PIPELINE EMPLOYEES
~~1130 SPUS0007 AV. NO. TRANSP. SERVICES EMPLOYEES~~
 1140 OTH11 AV. NO. OTHER SECTORS EMPLOYEES
~~1150 HWY11 AV. NO. HIGHWAY EMPLOYEES~~
 1160 SPGA0011 LOCAL SERVICE CARRIERS: AV. LABOR COSTS PER REVENUE TON-MILE
~~1170 SPGA0013 LOCAL SERVICE CARRIERS: AV. LABOR COSTS PER EMPLOYEE~~
 1180 SPGA0012 LOCAL SERVICE CARRIERS: REVENUE TON-MILES PER EMPLOYEE
~~1190 SPGA0014 TOTAL NO. EMPLOYEES FOR CERTIFIED ROUTE PLUS SUPPLEMENTAL AI~~
 1200 SPGA0015 TOTAL CERTIFICATED AIR CARRIERS
~~1210 SPGA0016~~
 1220 SPGA0017 TOTAL PASSENGER/CARGO CARRIERS
~~1230 SPGA0018 TOTAL FOR DOMESTIC TRUNKS~~
 1240 SPGA0019 DOMESTIC TRUNK-BIG FOUR
~~1250 SPGA0020 DOMESTIC TRUNK-OTHER TRUNKS~~
 1260 SPGA0021 PASSENGER/CARGO CARRIERS-LOCAL SERVICE
~~1270 SPGA0022 PASSENGER/CARGO CARRIERS-OTHER~~
 1280 SPGA0023 PASSENGER/CARGO CARRIERS-INTRA-ALASKA
~~1290 SPGA0024 PASSENGER/CARGO CARRIERS-INTRA-HAWAII~~
 1300 SPGA0025 DOMESTIC OPERATIONS/ALL-CARGO CARRIERS
~~1310 SPH0007 AVERAGE NUMBER OF F/T AND P/T EMPLOYEES - RAILWAY~~
 1320 SPH0005 AVERAGE NUMBER OF F/T AND P/T EMPLOYEES - LOCAL SUBURBAN HIGH
~~1330 SPUS0006 AV. NO. OF F/T AND P/T EMPLOYEES - MOTOR FREIGHT AND WAREHO~~
 1340 SPUS0009 AV. NO. OF F/T AND P/T EMPLOYEES - WATERWAYS
~~1350 SPGA0032 AV. NO. OF F/T AND P/T EMPLOYEES - AIR~~
 1360 SPUS0011 AV. NO. OF F/T AND P/T EMPLOYEES - PIPELINE
~~1370 SPUS0012 AV. NO. OF F/T AND P/T EMPLOYEES - SERVICE~~
 1380 SPH0008 AV. NO. OF F/T AND P/T EMPLOYEES - RAILWAY
~~1390 SPH0006 AV. NO. OF F/T AND P/T EMPLOYEES - LOCAL SUBURBAN AND HIGHWA~~
 1400 SPUS0013 AV. NO. OF F/T AND P/T EMPLOYEES - MOTOR FREIGHT AND WAREHO
~~1410 SPUS0014 AV. NO. OF F/T AND P/T EMPLOYEES - WATERWAYS~~
 1420 SPGA0031 AV. NO. OF F/T AND P/T EMPLOYEES - AIR
~~1430 SPUS0016 AV. NO. OF F/T AND P/T EMPLOYEES - PIPELINE~~
 1440 SPUS0017 AV. NO. OF F/T AND P/T EMPLOYEES - SERVICE
~~1450 SPH0009 WAGES AND SALARIES - RAILWAY~~
 1460 SPH0007 WAGES AND SALARIES - LOCAL SUBURBAN HIGHWAYS
~~1470 SPUS0018 WAGES AND SALARIES - MOTOR FREIGHT AND WAREHOUSING~~
 1480 SPUS0019 WAGES AND SALARIES - WATERWAYS
~~1490 SPGA0030 WAGES AND SALARIES - AIR~~
 1500 SPUS0021 WAGES AND SALARIES - PIPELINE
~~1510 SPUS0022 WAGES AND SALARIES - SERVICES~~
 1520 SPH0010 AV. ANNUAL EARNINGS PER F/T EMPLOYEE - RAILWAY
~~1530 SPH0008 AV. ANNUAL EARNINGS PER F/T EMPLOYEE - LOCAL SUBURBAN HIGHWA~~
 1540 SPUS0010 AV. ANNUAL EARNINGS PER F/T EMPLOYEES - MOTOR FREIGHT AND WA
~~1550 SPUS0015 AV. ANNUAL EARNINGS PER F/T EMPLOYEES - WATERWAYS~~
 1560 SPUS0020 AV. ANNUAL EARNINGS PER F/T EMPLOYEE - PIPELINE
~~1570 SPGA0033 AV. ANNUAL EARNINGS PER F/T EMPLOYEE - AIR~~
 1580 SPUS0023 AV. ANNUAL EARNINGS PER F/T EMPLOYEE - SERVICE
~~1590 SPUS0024 NUMBER OF EMPLOYEES: AUTO TAXI TRANSPORTATION SERVICE.~~

REPRODUCIBILITY OF THE
 ORIGINAL PAGE IS POOR

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1600 SPOS0025 NUMBER EMPLOYEES OF OPERATING COMPANIES.
~~1610 SPH00009 NUMBER OF ACCIDENTS FOR INTERCITY FOR-HIRE TRUCKS.~~
 1620 SPH00010 ACCIDENTS INVOLVING PRIVATE INTERCITY TRUCKS.
~~1630 SPH00012 ACCIDENTS INVOLVING LOCAL PRIVATE TRUCKS.~~
 1640 SPH00013 INTERCITY BUS EMPLOYEES - EMPLOYMENT
~~1650 SPH00014 INTERCITY BUS EMPLOYEES - PAYROLL~~
 1660 SPH00015 INTERCITY BUS EMPLOYEES - AVERAGE EARNINGS
~~1670 SPH00016 INTERCITY BUS DRIVERS - EMPLOYMENT~~
 1680 SPH00017 INTERCITY BUS DRIVERS - PAYROLL
~~1690 SPH00018 INTERCITY BUS DRIVERS - AVERAGE ANNUAL EARNINGS~~
 1700 PDM00002 TRUCK AND BUS FACTORY SALES (1921-70) - SOLD
~~1710 PDM00003 TRUCK AND BUS FACTORY SALES (1921-70) - GROSS SALES~~
 1720 PDM00004 AUTO. PASSENGER CARS AND TAXI VEHICLE REGISTRATIONS
~~1730 PDM00005 MOTORCYCLE REGISTRATIONS~~
 1740 POGA0016 AIR CARRIER - CERTIFICATED DOMESTIC OPERATIONS/ALL SERVICES
~~1750 POGA0017 AIR CARRIER - SUPPLEMENTAL DOMESTIC OPERATIONS~~
 1760 POGA0018 GENERAL AVIATION MILLION OF MILES
~~1770 PDM00006 BILLIONS OF PASSENGER CAR AND TAXI MILES~~
 1780 PDM00007 BILLIONS OF TRUCK HIGHWAY MILES
~~1790 PDM00008 VEHICLE MILES - INTERCITY BUS~~
 1800 PDM00009 VEHICLE MILES - SCHOOL BUS
~~1810 PDM00010 VEHICLE MILES - LOCAL TRANSIT~~
 1820 PDM00012 RAILROAD MILES - PASSENGER
~~1830 PDM00013 RAILROAD MILES - FREIGHT~~
 1840 PAMF20 MALES & FEMALES; 20 YEARS & OVER; POPULATION BY AGE.
~~1850 PAMF30 MALES & FEMALES; 30 THRU 49; POPULATION BY AGE.~~
 1860 PAM10 MALES; 16 THRU 19; POPULATION BY AGE.
~~1870 PAM20 MALES; 20 THRU 34;~~
 1880 PAM55 MALES; 55 YEARS & OVER; POPULATION BY AGE.
~~1890 PAM10 FEMALES; 16 THRU 19; POPULATION BY AGE.~~
 1900 PAF20 FEMALE; 20 YEARS AND OVER; POPULATION BY AGE.
~~1910 PEP TOTAL POPULATION; INCLUDING ARMED FORCES OVERSEAS.~~
² 1920 GPOP TOTAL POPULATION; INCL. ARMED FORCES OVERSEAS
² ~~1930 POPRES TOTAL RESIDENT POPULATION; INCL. ARMED FORCES.~~
² 1940 POPCIV TOTAL CIVILIAN RESIDENT POPULATION.
~~1950 LHA0 AGRICULTURAL EMPLOYMENT; CLF.~~
³ 1960 LHA0 MALES; 20+; EMPLOYMENT IN AGRICULTURE.
~~1970 LHA0 FEMALES; 20+; EMPL. IN AGRICULTURE; CLF.~~
³ 1980 LHA0 MF 16-19; EMPL IN AGRICULTURE; CLF.
~~1990 LURAG AGRICULTURAL M&S WORKERS. CLF; UNEMPL. RATE.~~
 2000 LUR09 FARM WORKERS; UNEMPL. RATE.
~~2010 GIRF FARM RESIDENTIAL STRUCTURES; PDI.~~
 2020 GVF CHANGE IN FARM BUSINESS INVENTORIES
~~2030 GIRF58 FARM RESIDENTIAL STRUCTURES; REAL PDI; 1958.~~
 2040 GVF58 CHANGE IN FARM BUSINESS INVENTORIES; REAL PDI; 1958
~~2050 GPF FARM BUSINESS GNP; PRIVATE; GNP BY SECTOR~~
 2060 GPF58 REAL FARM BUSINESS GNP 1958; PRIVATE; GNP58 BY SECTOR
~~2070 GPROF FARM PROPRIETORS' INCOME BY.~~
 2080 GYAFF AGRICULTURE, FORESTRY & FISHERIES INDUSTRIES INCOME
~~2090 GNP GROSS NATIONAL PRODUCT~~

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2100 POGA0020 U.S. CERT. ROUTE AIR CARRIER FORECAST (1971-81)
~~2110 POGA0019 TOTAL AIRCRAFT IN THE SERVICE OF U. S. AIR CARRIERS~~
2120 POGA0021 EST. FUEL CONSUMED BY U.S. DOMESTIC CIVIL AVIATION
~~2130 POGA0022 EST. DOMESTIC AIR CARRIER/TRANSPORT AIRCRAFT PRODUCED~~
2140 POGA0023 EST. DOMESTIC ROTARY WING/PISTON & TURBINE PRODUCED
~~2150 ECGA0041 BAL. OF TRADE - CIV. AIRCRAFT, ENGINE & PARTS~~
2160 ECGA0042 BAL. OF TRADE - IMPORTS AIRCRAFT ENGINES & PARTS
~~2170 ECGA0043 BAL. OF TRADE - EXPORTS AIRCRAFT ENGINES & PARTS~~
2180 POGA0024 PASSENGER FATALITIES PER 100 MILLION PASSENGER MILES
~~2190 POGA0025 ACCIDENTS PER 100 MILLION MILES~~
2200 POGA0026 FATAL ACCIDENTS PER 100000 AIRCRAFT HOURS FLOWN (WORLD)

~~READY~~

Operations Research, Inc.

MEMORANDUM

June 17, 1976

TO: R. Rollins
FROM: L. Kaplan
SUBJECT: Aviation Data Base Development and Application - Commercial Aircraft and Engine Shipments, U.S. and Worldwide.

This memorandum presents an example of the potential utility of the Aviation Data Base to OAST analysts. Basically, the system can be used to store data which is considered valuable for analysis of OAST programs. On-line data allows rapid access to reliable information, therefore, reducing time spent on research and providing data for quick reaction tasks.

The way in which this system can be used was illustrated in a previous memorandum (May 26, 1976 Progress Report) where the demand for agricultural aviation was projected through the year 2000. The necessary data was entered into the Aviation Data Base and is now available for future analysis. Another example has been developed to further demonstrate the utility of the system.

On June 11, 1976, ORI prepared a report for NASA Headquarters on worldwide and U.S. shipments of commercial aircraft for NASA's budget advocacy package. Both past data and future projections were provided. Most of this data was compiled by hand from government and industrial sources. None of the necessary data was in the Aviation Data Base or the GEMAP Data Bases. Had the Aviation Data Base been operative at that time, as it is now, that analysis could have been done in a fraction of the time it did take.

In the report the data was separately grouped by: 1) commercial transports, 2) general aviation aircraft, both fixed wing and helicopters and 3) aircraft engines. The data was further developed by ORI for entrance into the data base. The three groupings were changed into eight variables (see Table 1), four for U.S. manufacturers and four for worldwide shipments. All eight variables were entered into the economic data file of the Aviation Data Base. Each variable covers two ten year periods, 1966 - 1974 and 1975 - 1986. The first period contains actuals and the second projected data. All dollars are stated in 1975 constant dollars.

The new variables were entered into the Aviation Data Base via the update program (see May 26, 1976 Progress Report) which prints out a complete description of each variable, including the source, time span, type and frequency of the data. Hardcopied descriptions for each variable are provided in Figures 1 - 8. Graphic plots of the variables are presented in Figures 9 - 12.

Calculations were made with the system to determine total U.S. manufacturers aircraft shipments and total worldwide aircraft shipments for each year. This was done by simply adding together the four variables associated with each respective total. Figure 13 presents a graphic plot in time series format of the resulting calculation.

Aviation Data Base Development and Application - Commercial Aircraft and Engine Shipments, U.S. and Worldwide.

June 17, 1976

Page 2

Four additional variables were entered into permanent storage in the aviation data base. The variables contain low projections of U.S. manufacturer's shipments of commercial aircraft and engines. Their complete descriptions are in the variable description file under the following variable names:

ECGA1044

ECGA1045

ECGA1046

ECGA1047

Temporary variables were developed to graphically illustrate the total worldwide market (past and future) for commercial aircraft and engines and the United State's share of the market (see Figure 14). United States projected shipments are presented in two scenarios. The "high" projection assumes that the U.S. will retain its present market share and the "low" projection assumes the U.S. market share will reduce to 50 percent over the ten year period 1976-1985.

TABLE 1
 AVIATION DATA BASE
 VARIABLES FOR COMMERCIAL AIRCRAFT
 AND ENGINE SHIPMENTS U.S. AND WORLDWIDE

VARIABLE NAME	VARIABLE DESCRIPTION
ECGA0044	Commercial Transport Aircraft U.S. Manufacturer's Shipments
ECFA0010	Commercial Transport Aircraft Worldwide Shipments
ECGA0045	Civil General Aviation Fixed Wing Aircraft U.S. Manufacturer's Shipments
ECFA0011	Civil General Aviation Fixed Wing Aircraft Worldwide Shipments
ECGA0046	Commercial Helicopters U.S. Manufacturer's Shipments
ECFA0012	Commercial Helicopters Worldwide Shipments
ECGA0047	Commercial Aircraft Engines U.S. Manufacturer's Shipments
ECFA0013	Commercial Aircraft Engines Worldwide Shipments

CURRENT DATE: 06/16/76

VARIABLE NAME: ECGA0044

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM TRANSPORT AIRCRAFT US MFG SHIPMENTS

SOURCE: 1966-73-FAA STATISTICAL HANDBOOK 1974. AEROSPACE F
& F 1975/76 1975-EST 1976-85-BOEING TO SUBCOMMITTEE
ON AVIATION AND TRANS R&D76

DATE: 760616 FREQ: WHEN ESTIMATES ARE REVISED TIME SPAN: 1966-8
5

DESCRIPTION: COMMERCIAL TRANSPORT AIRCRAFT U.S. MANUFACTURERS
SHIPMENTS-ACTUAL (1966-1974) AND PROJECTED (1975-1985)

CURRENT DATE 06/16/76

VARIABLE NAME ECFA0010

FILE LOCATION ECDF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME COMM TRANSPORT AIRCRAFT WORLD SHIPMENTS

SOURCE PRESENTATION BY BOEING TO SUBCOMMITTEE ON AVIATION
AND TRANS R&D 1976

DATE 060616 FREQ. WHEN ESTIMATES ARE REVISED TIME SPAN 1966-3

DESCRIPTION COMMERCIAL TRANSPORT AIRCRAFT WORLDWIDE SHIPMENTS-ACTUAL
(1966-1974) AND PROJECTED (1975-1985)

CURRENT DATE 06/16/76

VARIABLE NAME ECGA0045

FILE LOCATION EODF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME CIVIL GEN AVIATION F-W AIRCRAFT US MFG SHIPMENTS

SOURCE GENERAL AVIATION MANUFACTURERS ASSOCIATION AND ORI

DATE 760616 FREQ WHEN EST. ARE REVISED TIME SPAN 1966-85

KEYWORDS FIXED WING

DESCRIPTION: CIVIL GENERAL AVIATION FIXED WING AIRCRAFT U S
MANUFACTURERS SHIPMENTS-ACTUAL (1966-75) AND PROJECTED
(1976-85) PROJECTIONS BY ORI FROM GAMA DATA

FIGURE 3.

CURRENT DATE 06/16/76

VARIABLE NAME ECFA0011

FILE LOCATION ECDF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME CIVIL GEN AVIATION F-W AIRCRAFT WORLD SHIPMENTS

SOURCE DEVELOPED BY ORI FROM AVIATION DATA SYSTEMS INC REPORT
ON NON-U.S. MFG WHICH SHOWS AIRCRAFT SHIPMENTS TO BE
9.3 PERCENT OF THE WORLDWIDE TOTAL

DATE 760616 FREQ WHEN EST ARE REVISED TIME SPAN 1966-85

KEYWORDS FIXED WING

DESCRIPTION CIVIL GENERAL AVIATION FIXED WING AIRCRAFT WORLD-
WIDE SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1976-85)

CURRENT DATE 06/16/76

VARIABLE NAME ECGA0046

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME: COMM HELICOPTERS US MFG SHIPMENTS

SOURCE AEROSPACE F & F AEROSPACE INDUSTRIES ASSOCIATION OF
AMERICA INDUSTRIAL OUTLOOK

DATE 750616 FREQ: WHEN EST. ARE REVISED TIME SPAN 1966-85

DESCRIPTION: COMMERCIAL HELICOPTERS U.S. MANUFACTURERS SHIPMENTS-ACTUAL
(1966-1974) AND PROJECTED (1975-85).

CURRENT DATE 06/16/76

VARIABLE NAME ECFA0012

FILE LOCATION ECDF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME COMM HELICOPTERS WORLD SHIPMENTS

SOURCE DEVELOPED BY ORI FROM U.S. DATA: ASSUMES U.S. RETAINS
ITS CURRENT MARKET SHARE OF 80.6 PERCENT OF THE WORLD
MARKET-COMMISSION OF EUROPEAN COMMUNITIES

DATE 760616 FREQ. WHEN EST. ARE REVISED TIME SPAN 1966-85

DESCRIPTION COMMERCIAL HELICOPTERS WORLDWIDE SHIPMENTS-ACTUAL
(1966-74) AND PROJECTED (1975-85)

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

CURRENT DATE 06/18/76

VARIABLE NAME ECGA0047

FILE LOCATION EODF TYPE 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME COMM AIRCRAFT ENGINES US MFG. SHIPMENTS

SOURCE 1966-75-U.S. INDUSTRIAL OUTLOOK 1974 75 76 DOC 1976-85-
FAA PROJECTIONS IN THEIR AVIATION FORECASTS FY 1967-87

DATE 760616 FREQ WHEN EST ARE REVISED TIME SPAN 1966-85

DESCRIPTION COMMERCIAL AIRCRAFT ENGINES U.S. MANUFACTURERS
SHIPMENTS-ACTUAL (1966-75) AND PROJECTED (1976-85)

FIGURE 7

CURRENT DATE 06/16/76

VARIABLE NAME ECFA0013

FILE LOCATION: ECDF TYPE: 1975 CONSTANT DOLLARS IN BILLIONS

LONG NAME COMM AIRCRAFT ENGINES WORLD SHIPMENTS

SOURCE DEVELOPED BY ORI ASSUMES U S PRODUCTION IS 90 PERCENT
OF WORLD MARKET-THE CHALLENGE OF FOREIGN COMPETITION
AIAA NOV. 1975

DATE: 760616 FREQ: WHEN EST ARE REVISED TIME SPAN 1966-85

DESCRIPTION COMMERCIAL AIRCRAFT ENGINES WORLDWIDE SHIPMENTS-ACTUAL
(1966-75)AND PROJECTED (1976-85)

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

FIGURE 8

COMMERCIAL AIRCRAFT SHIPMENTS

—— U S. MFG AIRCRAFT SHIPMENTS
----- WORLDWIDE AIRCRAFT SHIPMENTS

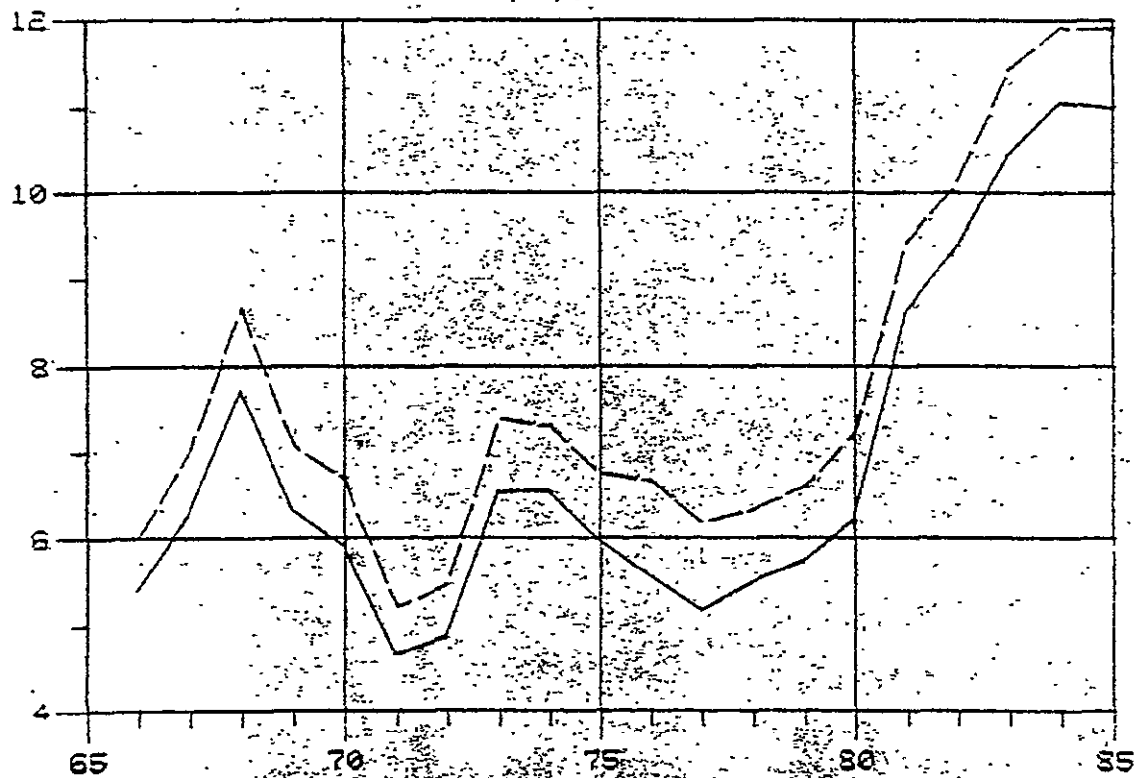


FIGURE 9

FIXED WING AIRCRAFT SHIPM

—— CIVIL GEN AVIATION F-W AIRCRAFT US MFG SHIPMENTS
----- CIVIL GEN AVIATION F-W AIRCRAFT WORLD SHIPMENTS

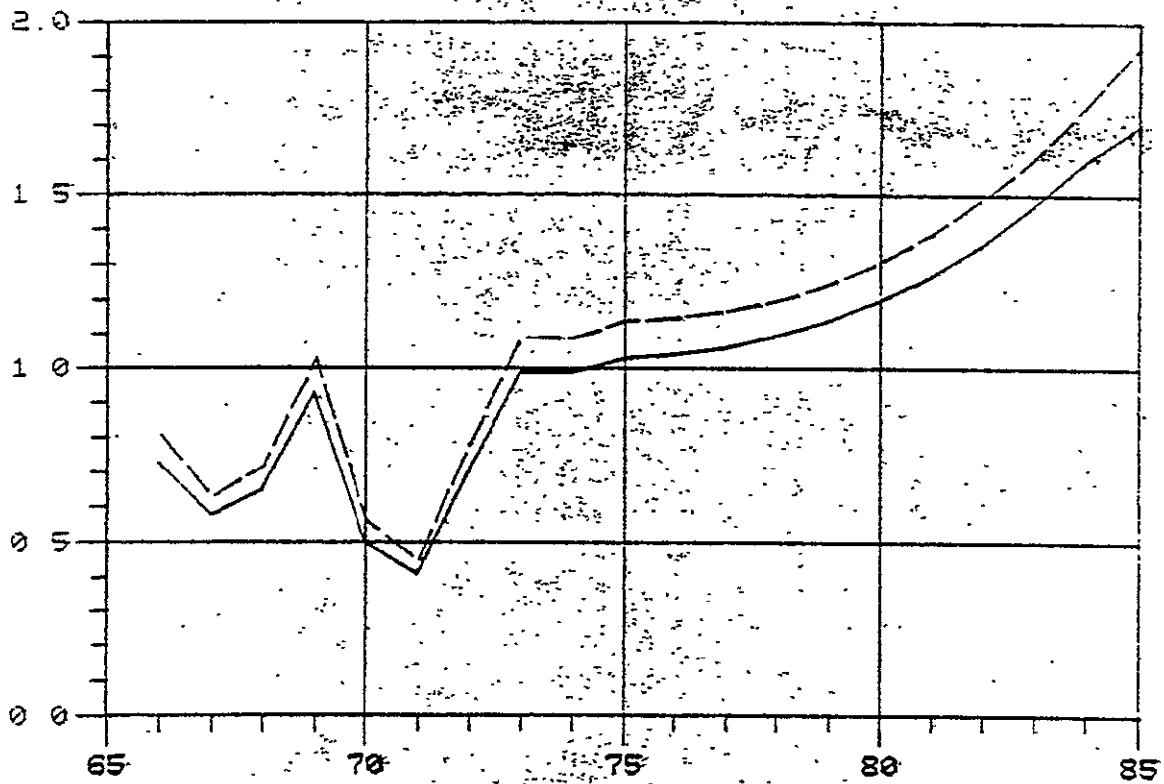
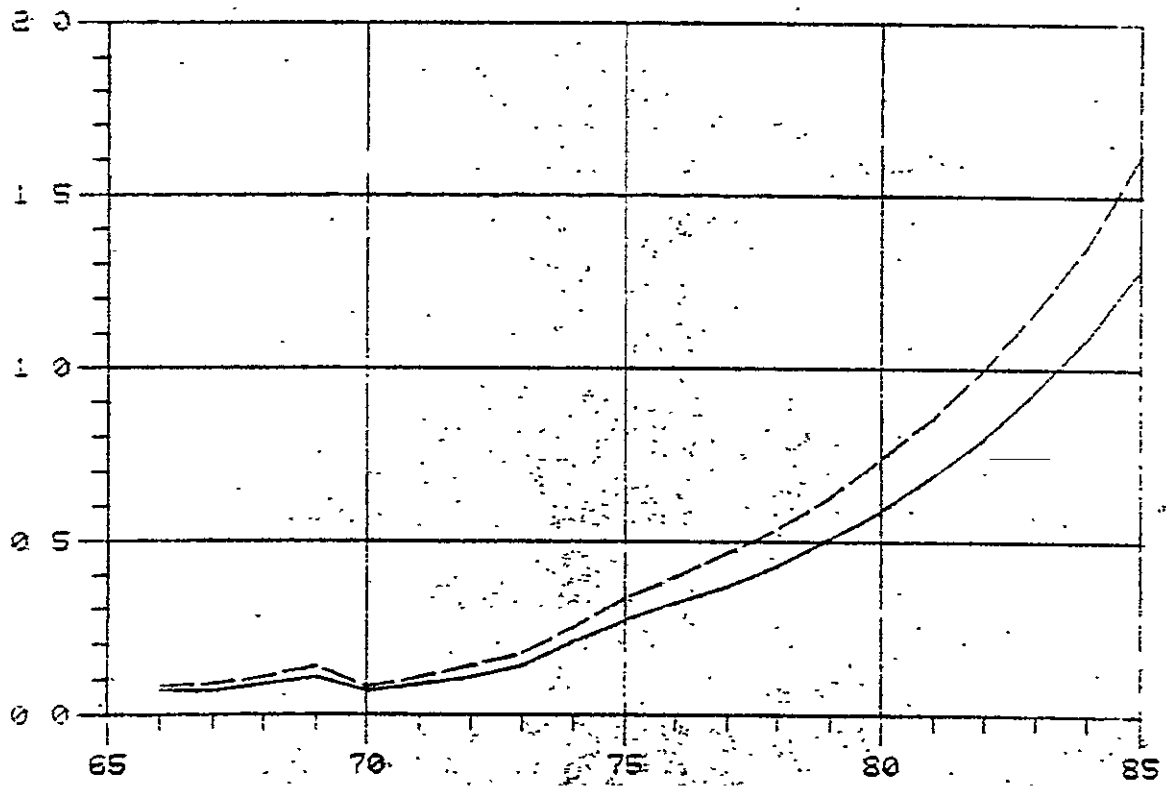


FIGURE 10

COMM HELICOPTER SHIP

— COMM HELICOPTERS US MFG SHIPMENTS
- - - COMM HELICOPTERS WORLD SHIPMENTS



- FIGURE 1.1

AIRCRAFT ENGINE SHIPMENTS

—— COMM AIRCRAFT ENGINES US MFG SHIPMENTS
----- COMM AIRCRAFT ENGINES WORLD SHIPMENTS

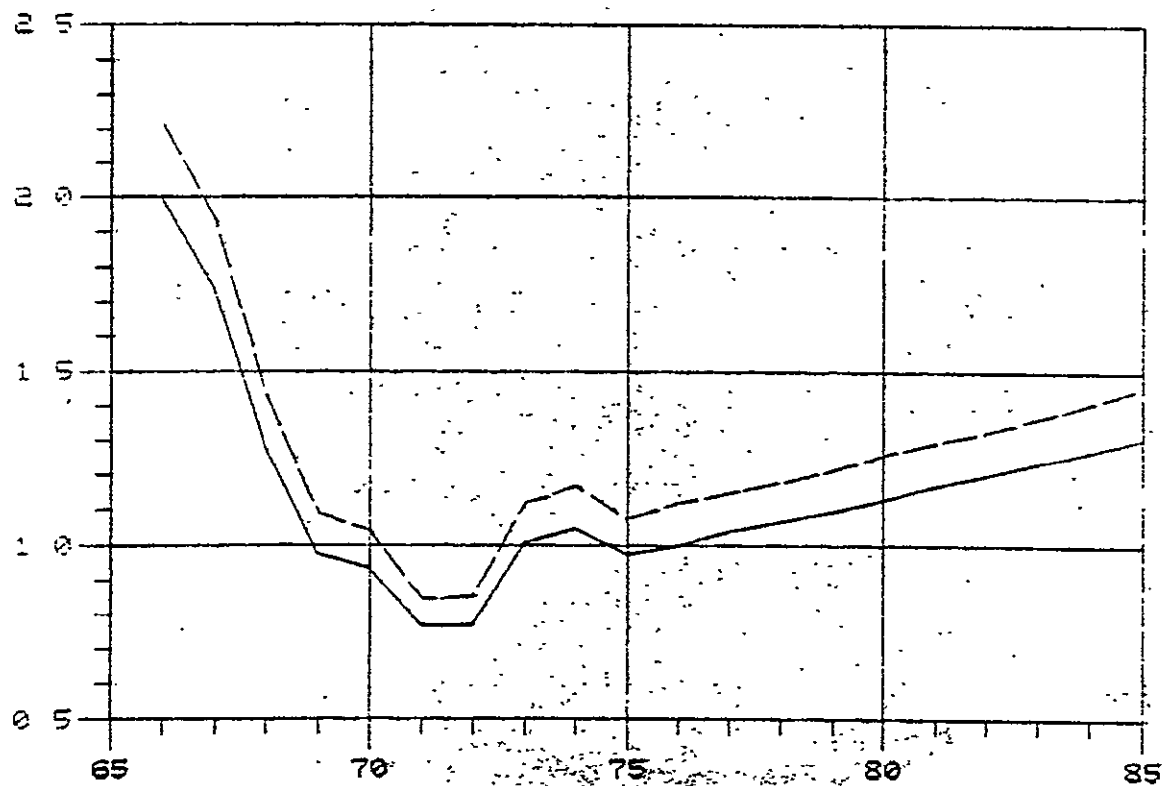


FIGURE 12

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

COMMERCIAL TRANSPORT SHIP

— COMM TRANSPORT AIRCRAFT US MFG SHIPMENTS
--- COMM TRANSPORT AIRCRAFT WORLD SHIPMENTS

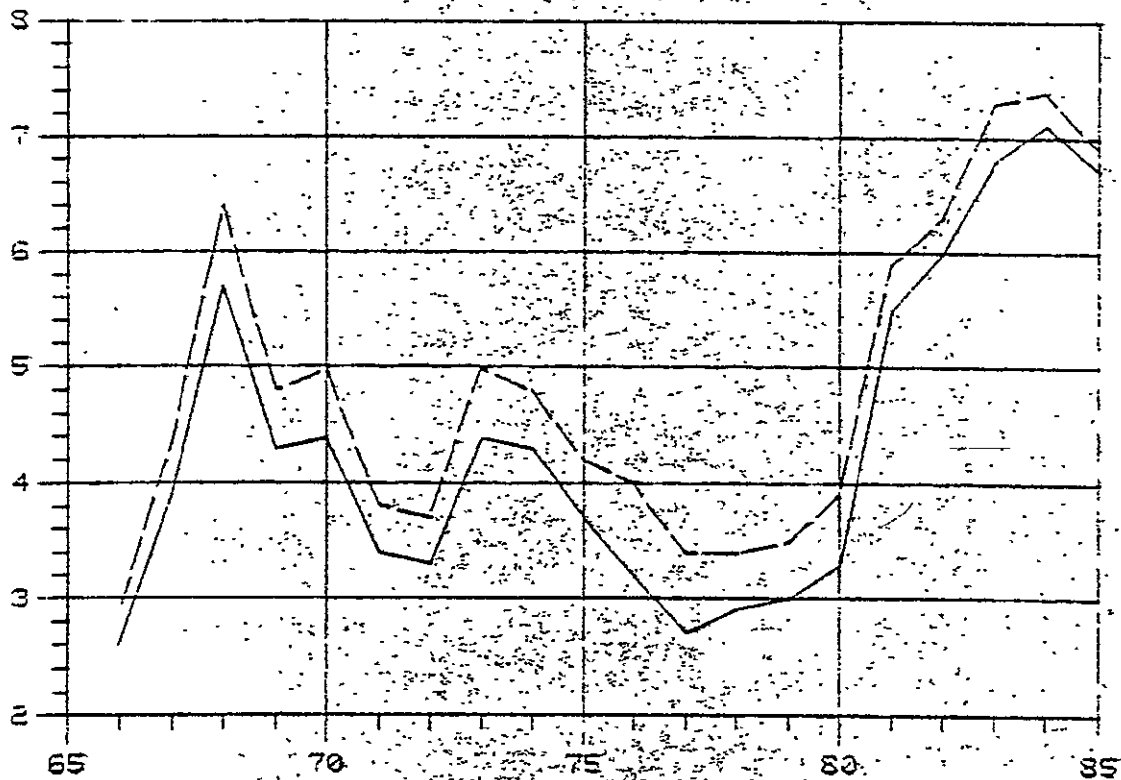
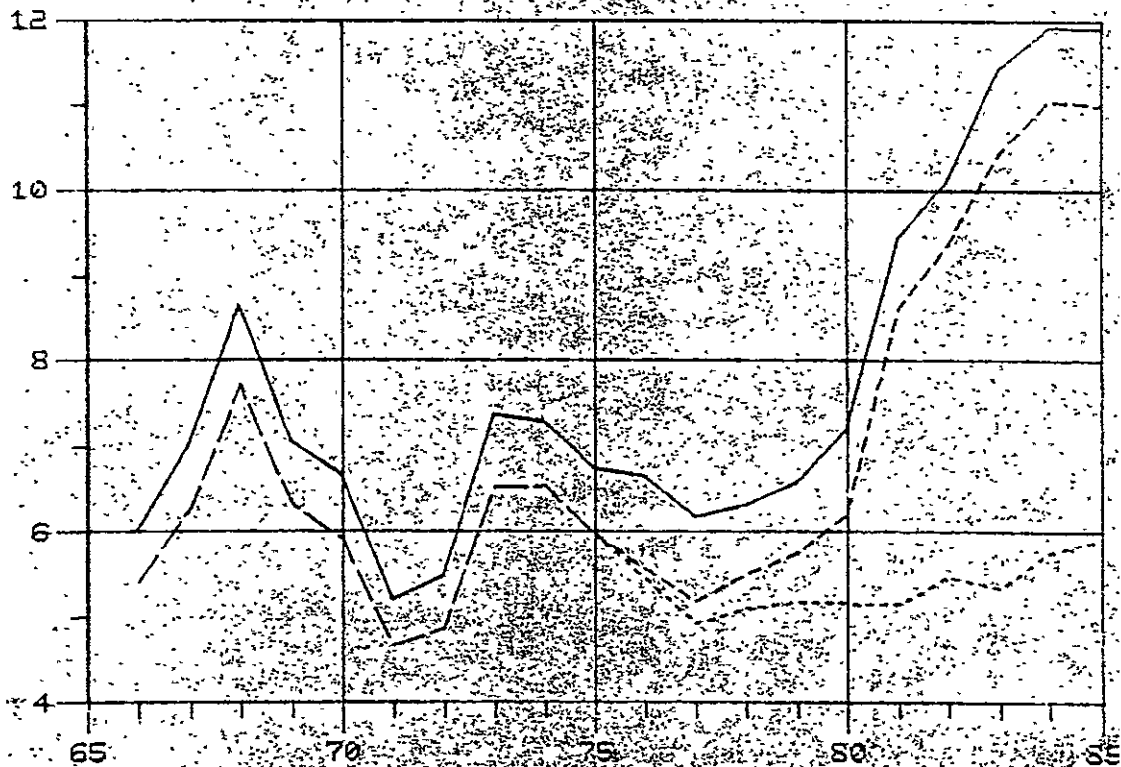


FIGURE 13.4

COMM AIRCRAFT AND ENGINE SHIPMENTS

_____ WORLD SHIPMENTS-ACTUALS AND PROJECTED
 _____ U.S. SHIPMENTS-ACTUALS
 - - - - - U.S. SHIPMENTS-PROJECTED (HIGH)
 U.S. SHIPMENTS-PROJECTED (LOW)



August 15, 1976

MEMORANDUM

TO: R. Rollins, NASA
FROM: L. Kaplan and D. Liston, ORI
SUBJECT: Technical Library Development

This memorandum presents a systems design for filing and retrieving technical documents leading to an Information Center, combining aviation data base activities and library functions. The system is illustrated by a flow chart in Attachment A.

DOCUMENT SELECTION AND PROCESSING

Non-technical administrative correspondence are processed and filed in a separate system described in a previous memorandum (Administrative Control Procedures, July 15, 1975).

Technical Documents shall be screened and selected for processing into the library by the professional staff. The professional staff will also perform the classifying and indexing functions included in document processing. A steady-state input flow of eight technical documents per week was estimated in a recent survey of incoming mail. The low input volume should occupy minimal staff time and will expedite more appropriate selection and processing than if the processes were performed by others not in the Study, Analysis and Planning Office's staff. The non-professional staff will be responsible for duplicate checking, accessioning, cataloging, posting and maintaining both the index and the physical library.

Document processing cards displayed in Attachments B and C should be attached to documents selected for the library and completed by cognizant staff members. Different colored cards will be used to distinguish between space and aeronautics documents. The cards are identical except for the classification categories:

Operations Research, Inc.

R. Rollins, NASA
Page Two

Professional Staff Functions

Input Screening and Selection of Documents. Document selectors will also be users. In this type of system specific document selection guidelines are unnecessary and documents must be selected in a subjective manner.

Classification. A preestablished classification scheme is presented on the backside of each of the document processing cards in Attachments B and C. The classifiers shall circle only one classification per document. The objectives of classification are:

- (1) To provide direct, physical access to the documents in the collection;
- (2) To provide an organized rationale for the shelving of documents that have been processed into the system;
- (3) To see at a glance the relative strengths and weaknesses of the collection in broad subject areas; and
- (4) To provide access by browsing the collection.

Indexing. Indexing will be done on both a subject and data basis. Data indexing will be distinguished from subject indexing by an asterisk placed to the right of a subject term identifying data actually present in the document.

Every effort will be made to select terms from the NASA Thesaurus. This will avoid duplication of similar subjects with different terms. New terms, not in the Thesaurus, will be placed in an ancillary card file.

Non-Professional Staff Functions

Duplicate Checking. To avoid duplication of documents in the library a card file will be developed consisting of one card for each document entering the system containing its exact title and accession number. Each document selected for entrance into the library should be checked against this file before processing to determine if it is a duplicate.

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Accessioning. Each document will receive a unique accession number which shall be stamped in the lower lefthand corner along the left edge of the title page. Documents comprised of several separate parts, such as series or volume, should be assigned consecutive numbers to keep them together throughout processing. All documents will be recorded in an accession log.

Cataloging. Cataloging is the procedure for entering all applicable data, except for classification and index terms, on the document processing card. Thus, in this system the cataloger would fill in the entire front side of the card (Attachments B and C). This includes the following information.

Accession Number
Publication Date
Issue
Author
Title
Agency
Report Number
Contract Number
Pagination

Shelving Documents. The completed documents will be placed in Princeton Files stored on the shelves in alpha-numeric order. That is, all documents in a class are placed together, and then arranged by accession number. The range of numbers in these files will be marked on the outside of the file as a guide to the document location. The shelves themselves will be labeled for classification.

Posting. Accession numbers are posted onto terminal digit index cards (Attachment D). Each card will represent one index term and ten numbered columns for posting. The last digit of an accession number will determine which column it should be posted in. Documents containing data will have an asterisk placed to the right of their accession numbers on the index cards.

Accession numbers will also be posted on a separate document under their classification categories. This will enable the searcher to locate documents by converting accession numbers to classification categories.

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Page Four

INFORMATION RETRIEVAL

Retrieval of specific subject matter or data may be accomplished by converting the subject into index terms through the NASA Thesaurus and then searching the index for these terms. The terminal digit index cards (Attachment D) contain ten numbered columns in which document accession numbers are listed with the last digit of the accession number corresponding to the column number. This method of grouping accession numbers enables the user to make Boolean searches. Boolean capabilities are necessary when searching for subject matter involving more than one concept and which may not have one term encompassing the combined concepts in the index. For example, when searching for material on technology transfers in medicine the user would search the index for the two terms: technology transfer and medicine. The columns of the two index cards can be easily compared to determine if there are corresponding accession numbers on both cards.

AVIATION DATA BASE

Data searches can be accomplished by searching either the data index for documents or the data base index for on-line data. Also data in documents may be processed into the data base if the frequency of data usage or the products sophistication justifies mechanization. Machine processing is clearly superior to manual processing when certain analyses, i.e., regression, are required. A procedural guide for using the Aviation Data Base and examples of the utility of the data base to OAST were provided in a previous memorandum (Aviation Data Base Development and Application-Progress Report, May 26, 1976).

LIBRARY FACILITY

The library facility will consist of seven or eight thirty-six by ten inch shelving units. The units may be arranged in one of the following alternative manners:

- Lengthwise against the wall in the hallway
- Lengthwise along a side wall and a backwall in one office

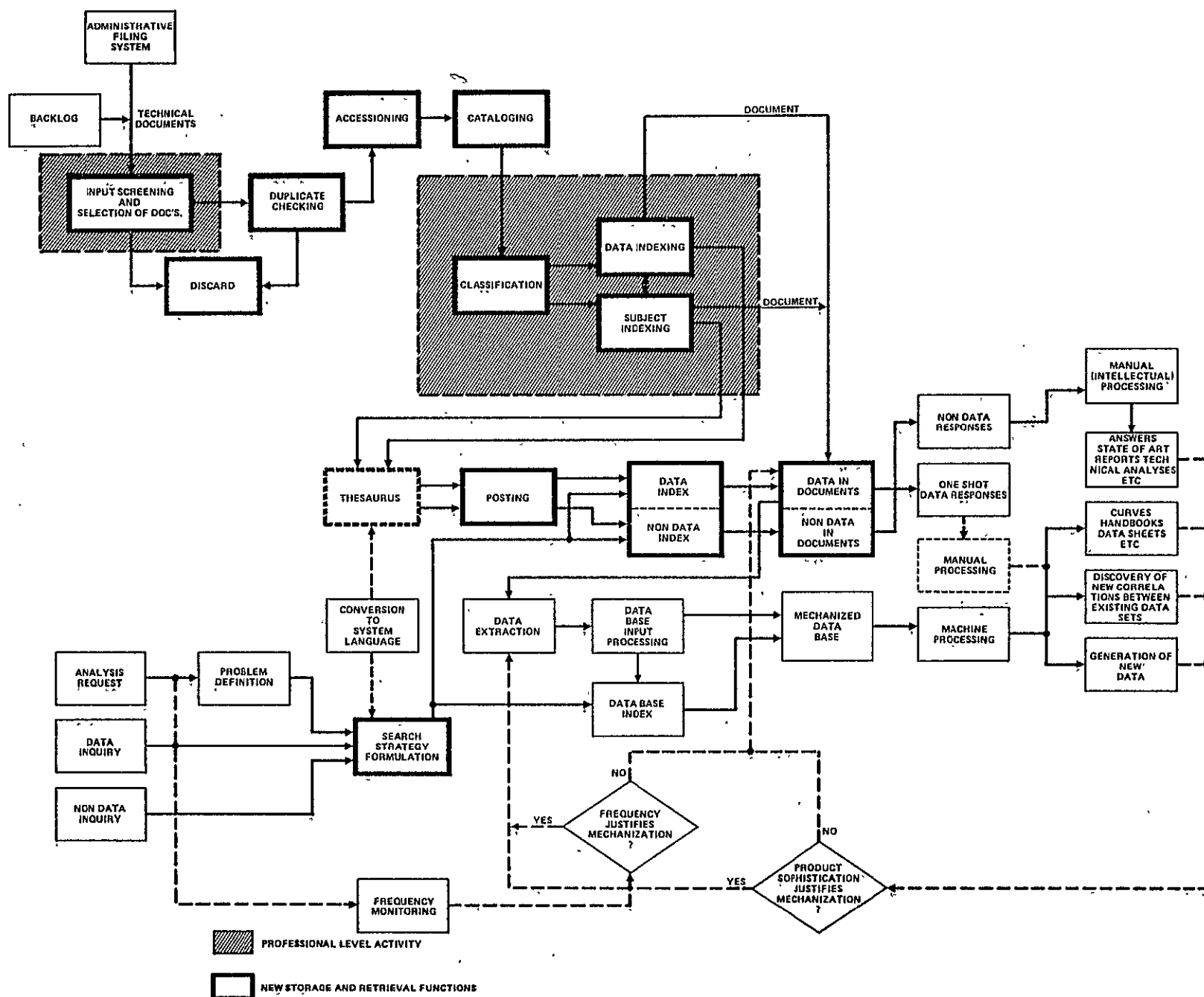
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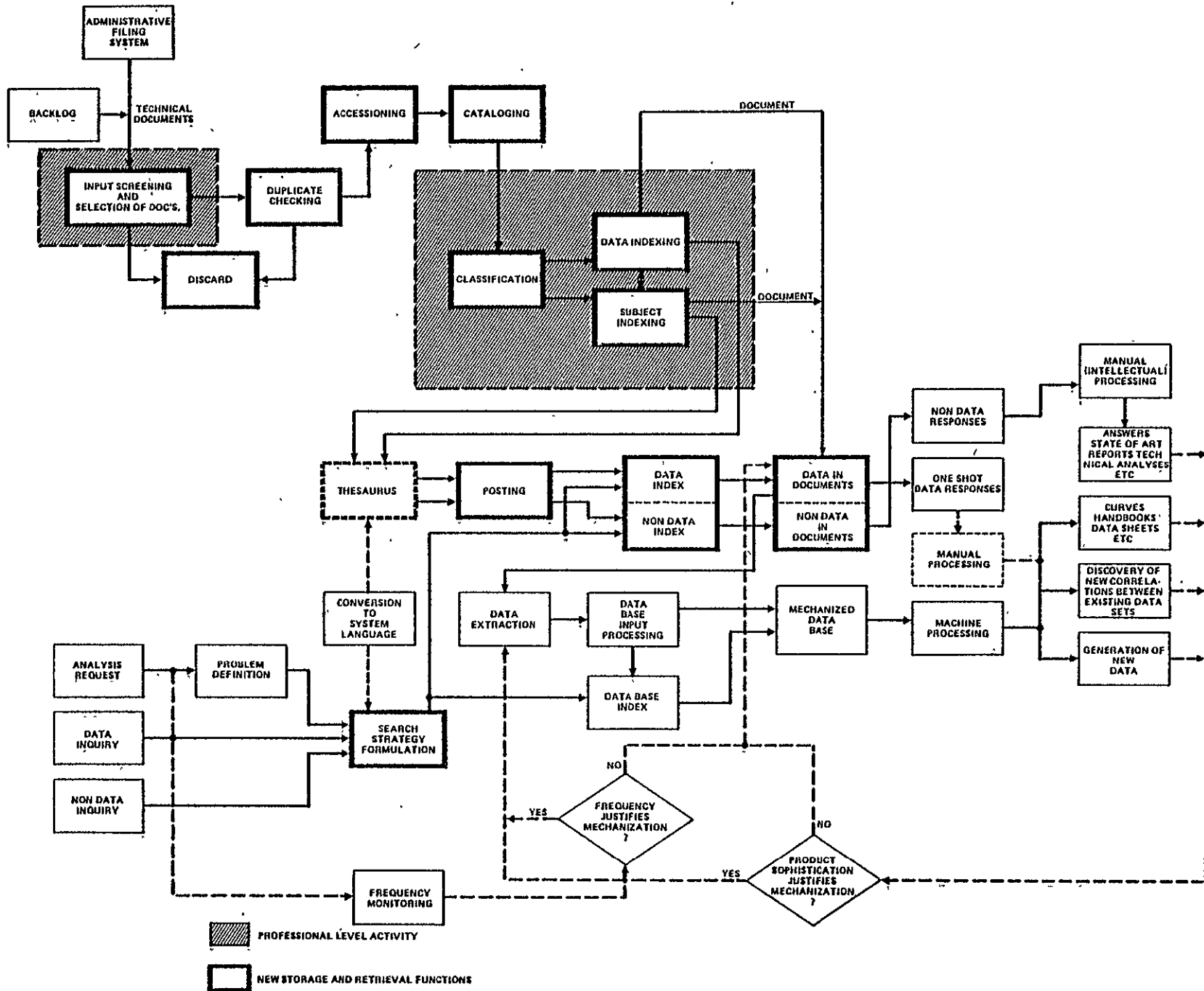
- Back to back perpendicular to the back walls in two offices with no more than four units in each office.

Each potential alternative is illustrated in Attachment E.

ATTACHMENT A SYSTEMS FLOWCHART



ATTACHMENT A SYSTEMS FLOWCHART



RX AERONAUTICS DOCUMENT PROCESSING CARD

ACCESSION NUMBER

PUB. DATE

ISSUE

AUTHOR

TITLE

AGENCY

CONTRACT NUMBER

REPORT NUMBER

PAGINATION

CLASSIFICATION

1. TECHNOLOGY SURVEILLANCE AND TERMS

- a. Foreign Technology
- b. International Competition
- c. Industry Trends
- d. Technology Forecasting

2. ECONOMIC SURVEILLANCE AND TRENDS

- a. Economic Data & Information Surveys
- b. Benefit-Cost Analysis
- c. Market Demand

5. OTHER AERONAUTICS

3. GOVERNMENT ROLE AND POLICY

- a. Decision Making Processes
- b. Policy Studies
- c. Socio/Political Trends
- d. Technology Impact Assessments

4. MISSION CONCEPTS

- a. Potential Technology Applications
- b. Civil/Military Technology Requirements Commonality
- c. Systems Characteristics
- d. Analytical Methods

INDEX TERMS

RX SPACE DOCUMENT PROCESSING CARD

ACCESSION NUMBER

PUB. DATE

ISSUE

AUTHOR

TITLE

AGENCY

CONTRACT NUMBER

REPORT NUMBER

PAGINATION

CLASSIFICATION

1. READINESS OF NEW TECHNOLOGY FOR NEAR-TERM MISSIONS
2. ASSESSMENT OF REQUIRED ENABLING TECHNOLOGY FOR FUTURE MISSIONS
3. ADVANCED MISSION CONCEPTS
4. SYSTEMS ANALYSIS, METHODOLOGY AND SUPPORT
5. OTHER SPACE

INDEX TERMS

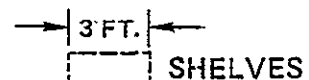
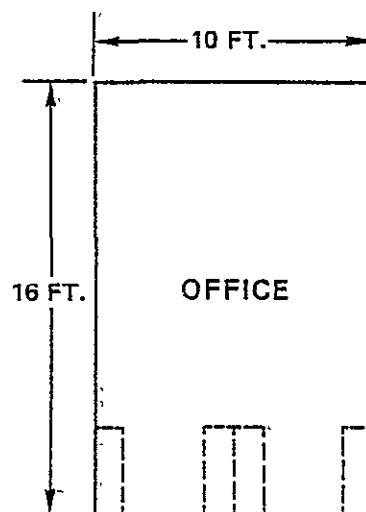
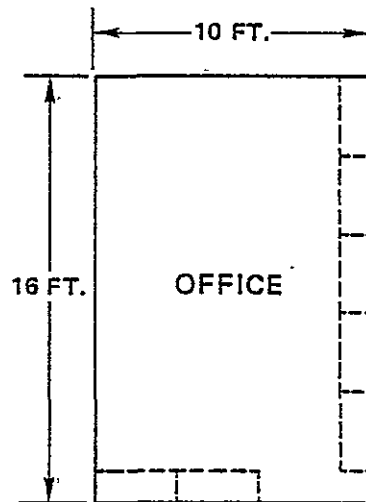
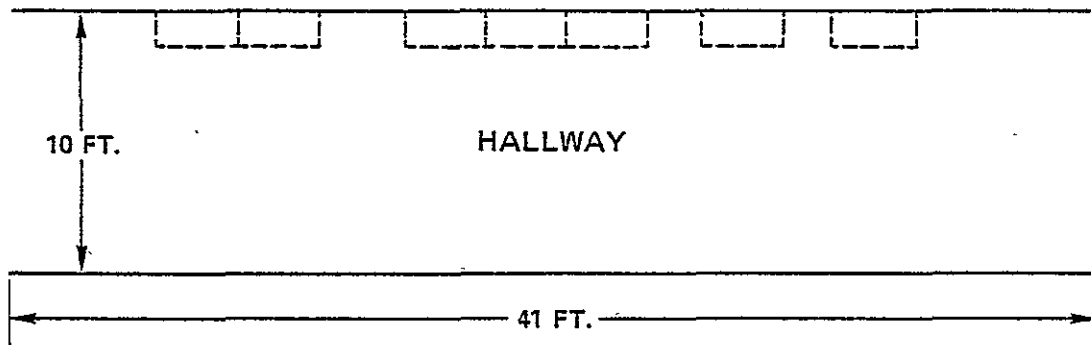
ATTACHMENT D

TERMINAL DIGIT CARD

[illegible]

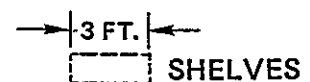
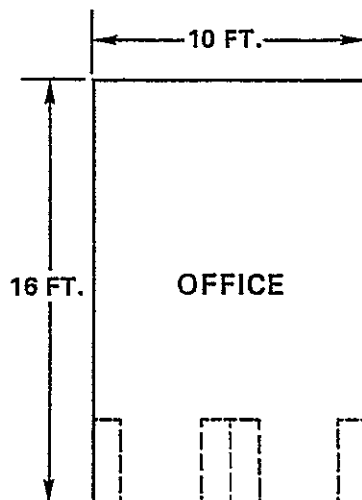
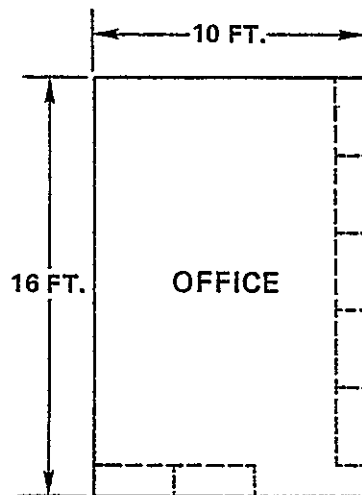
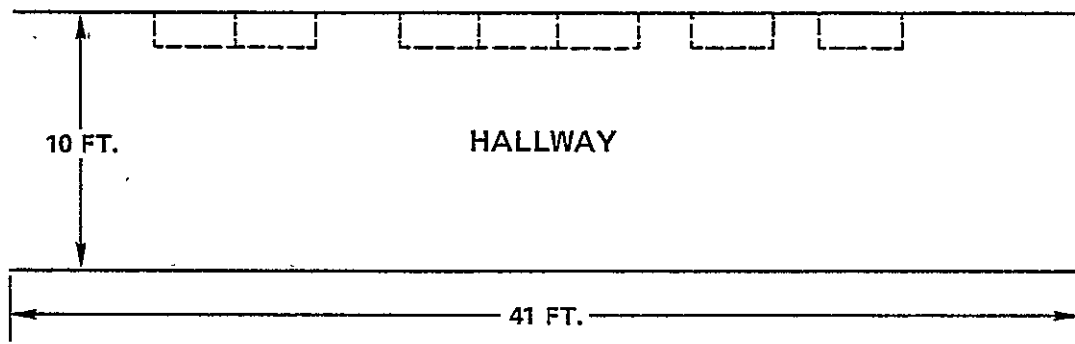
ATTACHMENT E

POTENTIAL ALTERNATIVE LIBRARY FACILITY ARRANGEMENTS



ATTACHMENT E

POTENTIAL ALTERNATIVE LIBRARY FACILITY ARRANGEMENTS



COMMERCIAL AIRCRAFT
U.S. AND WORLDWIDE SHIPMENTS
1966 - 1985

Prepared by:
OPERATIONS RESEARCH, INC.
June 3, 1976

LIST OF TABLES AND ILLUSTRATIONS

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INTRODUCTION AND SUMMARY

INTRODUCTION

This report covers worldwide shipments (excluding USSR and Peoples Republic of China) of civilian aircraft and aircraft engines. The data are separately grouped by: 1) commercial transports, 2) general aviation aircraft, both fixed-wing and helicopters, and 3) aircraft engines. Two ten year periods are covered, 1966-1975 and 1976-1985. All dollars are stated in 1975 constant dollars.

All data was obtained from documented authoritative sources which are cited on the attached charts and are available for examination. In addition, information was obtained from various persons in industry, aircraft associations, and government agencies. Actual reported data was used for 1966-1974 together with reported estimates for 1975 to develop the data used for the 1966-1975 time period.

SUMMARY

As shown in Figure S-1 and Table S-1, the total worldwide shipments during the period 1966-1975 were \$68.0 billion of which the U.S. share of the market was \$60.6 billion (89 percent). The projections for the worldwide market for 1976-1985 range from a low of \$73.1 billion to a high of \$87.8 billion. The U.S. share of the market for the 1976-1985 period ranges from a low of \$53.6 billion to a high of \$79.2 billion.

Table 1 shows that commercial transport shipments in the 1966-1975 period were \$45.3 billion worldwide of which the U.S. share of the market was \$40.3 billion (89 percent).

Tables 2 and 3 show that the projections for the worldwide market for 1976-1985 range from a low of \$47.8 billion by AECMA to a high of \$54.4 billion by AIAA. For the U.S. share of the worldwide market, the projections

range from a low of \$31.0 billion by Boeing to a high of \$49.5 billion by AIAA. On the low side this would reduce the U.S. share of the civil transport market from 89 percent in 1966-1975 to 64.9 percent and on the high side increase the U.S. share to 91 percent.

Projections of worldwide shipments of commercial transports for the 1976-1985 time period used in this report were made by the Boeing Commercial Airplane Company, The Aerospace Industries Association of America (AIAA), Douglas Aircraft Company, the Commission of the European Communities (EEC) and the Association Européenne de Constructeurs de Matériel Aérospatial (AECMA).

Data on general aviation and aircraft engines are shown in Tables 4-9. Tables 4-5 cover civil general aviation fixed-wing aircraft and Tables 6-7 cover commercial helicopters. Data on shipments of new aircraft engines are provided in Tables 8 and 9.

The principal sources of data for Tables 4-9 are: Federal Aviation Administration, Department of Commerce, Aerospace Industries Association of America, General Aviation Manufacturers Association, and Aviation Data Systems, Inc..

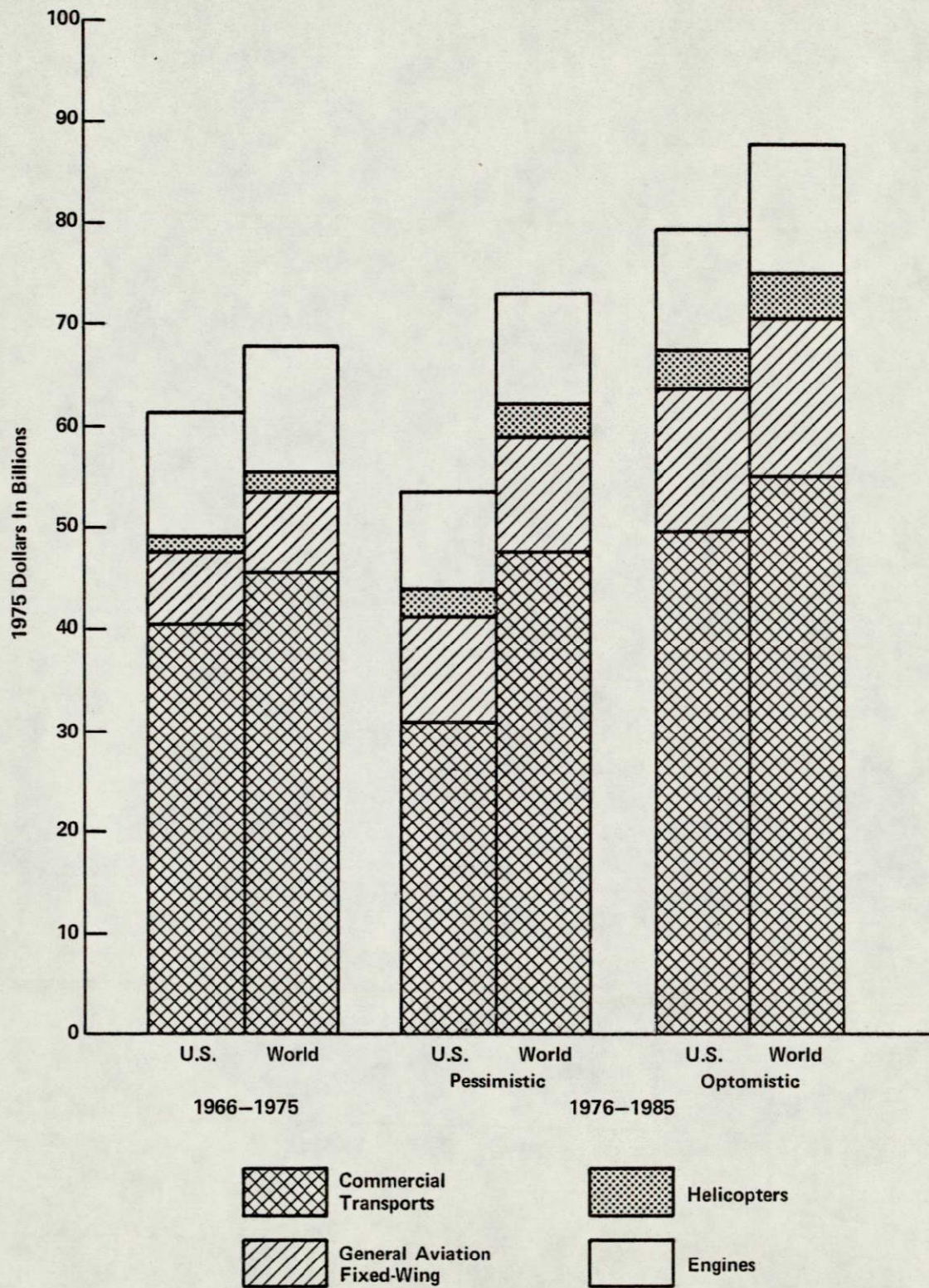


FIGURE S-1. COMMERCIAL AIRCRAFT SHIPMENTS, 1966-1985
(1975 CONSTANT DOLLARS)

TABLE S-1
COMMERCIAL AIRCRAFT SHIPMENTS
U.S. AND WORLDWIDE
(1975 Constant Dollars in Billions)

AIRCRAFT	1966-75		1976-85			
	U.S.	World	Low		High	
			U.S.	World	U.S.	World
TRANSPORTS	40.3	45.3	31.0	47.8	49.5	54.4
General Aviation						
Fixed Wing	7.5	8.3	10.1	11.1	14.4	15.9
Helicopters	1.3	1.6	2.7	3.3	3.7	4.6
AIRCRAFT ENGINES	11.5	12.8	9.8	10.9	11.6	12.9
TOTAL SHIPMENTS	60.6	68.0	53.6	73.1	79.2	87.8

TABLE 1
COMMERCIAL TRANSPORT AIRCRAFT
Shipments by U.S. Manufacturers
1966 - 1975

<u>Years</u>	<u>Units</u>	<u>Dollar Value (Billions)^{1/}</u>
1966	322	2.6
1967	500	3.9
1968	702	5.7
1969	509	4.3
1970	311	4.4
1971	230	3.4
1972	230	3.3
1973	295	4.4
1974	332	4.3
1975	<u>310</u>	<u>3.7</u>
TOTALS		
U.S.	3741	40.3
REST OF WORLD	639	5.0
WORLD MARKET	4380 ^{2/}	45.3 ^{2/}

^{1/} 1975 Constant Dollars. Total does not add due to rounding.

^{2/} U.S. Share of the World Market (Excluding USSR and Peoples Republic of China) is 85.4% for units and 88.9% for dollars. Based on the Challenge of Foreign Competition, Nov. 1975, AIAA.

SOURCES: 1966 - 1973 - FAA Statistical Handbook of Aviation
Calendar Year 1974, FAA.

1974 - Aerospace Facts & Figures, 1975/76, AIAA

1975 - Estimated, U.S. Industrial Outlook 1976, DOC

TABLE 2
 - COMMERCIAL TRANSPORT AIRCRAFT
 Estimated World-wide Shipments
 1976 - 1985

<u>Years.</u>	<u>DOUGLAS^{1/}</u>		<u>BOEING^{2/}</u>
	<u>Units</u>	<u>Dollar Value (Billions)^{3/}</u>	<u>Dollar Value (Billions)^{3/}</u>
1976	198	2.7	4.0
1977	203	3.0	3.4
1978	225	3.6	3.4
1979	287	4.8	3.5
1980	354	6.5	3.9
1981	391	7.6	5.9
1982	341	6.7	6.3
1983	299	6.0	7.3
1984	303	6.2	7.4
1985	280	5.9	6.9
TOTAL WORLD	2881	52.9 ^{4/}	52.0

^{1/} Douglas Aircraft Company Report - C1-804-3672A, The Passenger Air Transport Market, 1975 - 1990, June 1975.

^{2/} Presentation by Boeing Commercial Airplane Company, Future of Aviation, National Transportation System, to the Subcommittee on Aviation and Transportation R&D, May 11, 1976. Data compiled from graph and are estimates only.

^{3/} 1975 constant dollars.

^{4/} Does not add due to rounding.

TABLE 3
COMMERCIAL TRANSPORT AIRCRAFT
Shipments 1976 - 1985
(1975 Constant Dollars in Billions)

	WORLD MARKET	U.S. SHARE			
		HIGH		LOW	
		\$	%	\$	%
AECMA ^{1/}	47.8	41.7	87.2	38.5	80.6
AIAA ^{2/}	54.4	49.5	91.0	46.2	85.0
BOEING ^{3/}	52.0	47.2	90.8	31.0	59.6
DOUGLAS ^{4/}	52.9				
EEC ^{5/}	53.4	46.4	86.9	37.2	69.6

^{1/} Commission of the European Communities, Action Programme for the Aeronautical Sector, Brussels, Oct. 1975

^{2/} The Challenge of Foreign Competition, Research Report, November 1975, AIAA

^{3/} Presentation by Boeing Commercial Airplane Company, Future of Aviation, National Transportation System, for the Subcommittee on Aviation and Transportation R&D, May 11, 1976. Data compiled from graph and are estimates only.

^{4/} Douglas Aircraft Company Report - C1-804-3672A, The Passenger Air Transport Market, 1975 - 1990, June 1975.

^{5/} Commission of the European Communities, op. cit.

TABLE 4
CIVIL GENERAL AVIATION FIXED-WING AIRCRAFT
Shipments by U.S. Manufacturers
1966 - 1975

<u>Year</u>	<u>Units</u>	<u>Dollar Value (Millions)^{1/}</u>
1966	15,768	732.3
1967	13,577	575.0
1968	13,698	651.2
1969	12,591	930.7
1970	7,402	503.6
1971	7,464	412.0
1972	9,774	704.2
1973	13,646	988.0
1974	14,166	988.5
1975	<u>14,072</u>	<u>1032.0</u>
 <u>TOTALS</u>	 <u>Units</u>	 <u>Dollar Value (Millions)</u>
U.S.	122,429	7517.5
REST OF WORLD ^{2/}	12,553	770.8
WORLD MARKET	134,982	8288.3

^{1/} 1975 Constant dollars

^{2/} Aviation Data Systems, Inc. report on non-U.S. manufactured shows aircraft shipments to be 9.3 percent of world-wide total for 1967-69.

SOURCE: 1966 - 75-Stimpson, Edward W. and J. R. Merinar, General Aviation Manufacturers Association before the Aerospace Analysts Society, New York City, February 6, 1976.

TABLE 5
CIVIL GENERAL AVIATION FIXED-WING AIRCRAFT
Estimated Shipments by U.S. Manufacturers
1976 - 1985
NUMBER OF AIRCRAFT

<u>Year</u>	<u>GAMA^{1/}</u>	<u>FAA^{2/}</u>
1976	14,916.	13,059
1977	15,810	12,948
1978	16,760	13,067
1979	17,765	13,815
1980	18,831	14,301
1981	19,961	14,638
1982	21,159	13,860
1983	22,428	13,860
1984	23,774	13,860
1985	25,200	13,860

<u>TOTALS</u>	<u>Units</u>	<u>Dollar Value^{3/}</u> <u>(Billions)</u>	<u>Units</u>	<u>Dollar Value^{3/}</u> <u>(Billions)</u>
U.S.	196,604	14.4	137,246	10.1
REST OF WORLD ^{4/}	20,159	1.5	14,073	1.0
WORLD MARKET	216,763	15.9	151,319.	11.1

^{1/}Stimpson, Op. Cit. p. 4, projects long-term compounded annual growth at 6 percent per year.

^{2/}Aviation Forecasts, Fiscal Years 1976-1987, FAA, September 1975.

^{3/}1975 Constant Dollars.

^{4/}Assumes U.S. retains 90.7 percent of world market.

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TABLE 6
COMMERCIAL HELICOPTERS
Shipments by U.S. Manufacturers
1966 - 1975

<u>Year</u>	<u>Units</u>	<u>Average Unit Costs^{1/} (\$000)</u>	<u>Dollar Value (Millions)^{1/}</u>
1966	583	112.9	65.8
1967	454	151.5	68.8
1968	528	165.2	87.2
1969	510	214.3	109.3
1970	495	137.0	67.8
1971	453	200.4	90.8
1972	575	197.9	113.8
1973	770	187.5	144.4
1974	828	248.1	205.4
1975 ^{2/}	<u>1100</u>	<u>300.0</u>	<u>330.0</u>
TOTALS			
U.S.	6296		1283.3
REST OF WORLD	<u>1515^{3/}</u>		<u>308.9</u>
WORLD MARKET	7811		1592.2

^{1/} 1975 Constant dollars.

^{2/} Forecast - Bureau of Domestic Commerce, DOC.

^{3/} U.S. has 80.6 percent of world market, Commission of The European Communities, op. cit. Excludes USSR and Peoples Republic of China.

SOURCES: 1966-67-Aerospace Facts and Figures, Aerospace Industries Association of America, Inc.
1968-75 - Industrial Outlook, Department of Commerce.

TABLE 7
COMMERCIAL HELICOPTERS

Estimated Shipments by U.S. Manufacturers
1976 - 1985

Year	FAA ^{1/}		ALTERNATIVE	
	Units	Dollar Value (Millions) ^{2/}	Units	Dollar Value (Millions) ^{2/}
1976	828	257	1,200 ^{3/}	372
1977	821	255		
1978	836	259		
1979	841	261		
1980	850	264		
1981	864	268		
1982	870	270		
1983	880	273		
1984	890	276		
1985	900	279		
TOTALS				
U.S.	8,580	2,660 ^{4/}	12,000 ^{5/}	3,720
REST OF WORLD ^{6/}	2,065	640	2,888	895
WORLD MAR- KET	10,645	3,300	14,888	4,615

^{1/} 1976 - 1982, Aviation Forecasts Fiscal Years 1976-1987, FAA, Sept. 1975, p. 39. (1983-85 FAA projections extended at average 1.1% growth rate.)

^{2/} Unit cost assumed as \$310,000, Bureau of Domestic Commerce, 1976 projection. (1975 constant dollars).

^{3/} U.S. Industrial Outlook 1976, DOC.

^{4/} Does not add due to rounding.

^{5/} Assumes no growth after 1976.

^{6/} Assumes U.S. retains 80.6 percent of world market excludes USSR and Peoples Republic of China.

TABLE 8
COMMERCIAL AIRCRAFT ENGINES
Shipments 1966 - 1975
(1975 Constant Dollars in Millions)

<u>Year</u>	<u>Dollar Value</u>
1966	2,000.8
1967	1,739.1
1968	1,282.6
1969	978.5
1970	937.7
1971	766.4
1972	770.2
1973	1,011.2
1974	1,050.4
1975	<u>975.9</u>
TOTALS	
U.S.	11,512.8
REST OF WORLD ^{1/}	1,279.2
WORLD MARKET	12,792.0

^{1/} Assumes U.S. production is 90 percent of world market. The Challenge of Foreign Competition, AIAA, November 1975, p.12 shows U.S. manufactured engines in the worldwide inventory of commercial jet transports as of June 1974 to be 86.7 percent of total excluding USSR and Peoples Republic of China.

U.S. manufactures about 90 percent of all general aviation aircraft, see Table 4.

SOURCES: 1965 - Estimated from Aerospace Facts and Figures, 1974/75.
1966-75 - U.S. Industrial Outlook, 1974, 1975, 1976, DOC.

TABLE 9
COMMERCIAL AIRCRAFT ENGINES
Estimated Shipments 1976 - 1985
(1975 Constant Dollars in Millions)

<u>Year</u>	<u>Dollar Value</u>
1976	1,005
1977	1,095
1978	1,148
1979	1,146
1980	1,191
1981	1,211
1982	1,211
1983	1,211
1984	1,211
1985	<u>1,211</u>

TOTALS:

U.S.	11,640
REST OF WORLD ^{1/}	1,293
WORLD MARKET ^{2/}	12,933

^{1/} Assumes U.S. retains 90.0 percent of world market excluding USSR and Peoples Republic of China.

^{2/} The Challenge of Foreign Competition, Research Report, Nov. 1975, AIAA estimates a \$10.9 billion (1975 dollars) new engine requirement worldwide in the next decade.

SOURCES: 1976 - U.S. Industrial Outlook, 1976, DOC
1977-82 - Aviation Forecasts Fiscal Years
1976-1987, FAA. Change in year to year
unit production was applied to 1976
estimated dollar value of shipments.
No growth was assumed for 1982-85.

COMMERCIAL AIRCRAFT
U.S. AND WORLDWIDE SHIPMENTS
BY AIRCRAFT TYPES
1975 - 1985

Prepared by:
Operations Research, Inc.
Revised July 8, 1976

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INTRODUCTION AND SUMMARY

INTRODUCTION

This report covers estimated worldwide shipments (excluding USSR and Peoples Republic of China) of civilian transport aircraft for the period 1976-1985. Two separate reports, Boeing based on Mr. Steiner's presentation to the Subcommittee on Aviation, May 11, 1976 and Douglas, The Passenger Air Transport Market, 1975-1990, June 1975 were used in developing the estimates in this report. These data were supplemented by telephone information provided on June 30, 1976 by Mr. John Granville, Boeing (Mr. Steiner's Office). The reported data shows the 10 year aircraft deliveries and the contested market by the following aircraft types: Long Range, Short/Medium Range, STOL/Feeder Jets, and SST. The data is displayed in 6 tables and 2 figures.

SUMMARY

As shown in Table 1 and Figure 1 the 10 year aircraft deliveries are estimated by Boeing as 3096. Of these deliveries, U.S., on the low side, is expected to produce 1545 aircraft if no new aircraft are introduced in this 10 year period. It further shows that U.S. may start losing a good share of the world market starting in 1980. This possible lost market is identified as the "Contested Market" of 1136 aircraft. Also shown is an uncontested non-U.S. market of 415 aircraft.

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Tables 2 through 6 and Figure 2 display the aircraft by type, identify the market share, U.S. versus non-U.S. and show the contested market. In summary, U.S. manufacturers have an uncontested market for the 612 long range aircraft estimated for delivery in the 10 year period, whereas the European market is uncontested during the same period for STOL/Feeder Jet and SST aircraft. The contested market of 1136 aircraft is all in the short/medium range aircraft.

The principal sources of data used in this report are: Boeing, Future of Aviation, National Transportation System, Subcommittee on Aviation and Transportation R&D, A Manufacturers Viewpoint, May 11, 1976 (Steiner presentation), information provided by Mr. John Granville, Boeing (Mr. Steiner's office) on June 30, 1976 and Douglas Aircraft Company, The Passenger Air Transportation Market, 1975-1990, June 1975.

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TABLE 1
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
U.S. HIGH, LOW AND CONTESTED MARKET
1976-1985

<u>YEAR</u>	<u>WORLD</u>	<u>U.S. SHARE</u>		<u>CONTESTED</u>
		<u>HIGH</u>	<u>LOW</u>	
1976	212	167	167	0
1977	216	162	162	0
1978	237	196	196	0
1979	306	260	260	0
1980	382	342	157	185
1981	422	382	133	249
1982	367	323	127	196
1983	324	288	113	175
1984	328	291	120	171
1985	<u>302</u>	<u>270</u>	<u>110</u>	<u>160</u>
TOTAL	3096	2681	1545	1136

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TABLE 2
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS, BY TYPE
1976-1985

<u>YEAR</u>	<u>TOTAL</u>	<u>LONG RANGE</u>	<u>SHORT/ MEDIUM RANGE</u>	<u>STOL/ FEEDER JET</u>	<u>SST</u>
1976	212	43	146	18	5
1977	216	50	134	24	8
1978	237	66	152	16	3
1979	306	85	197	24	
1980	382	70	294	18	
1981	422	72	332	18	
1982	367	66	280	21	
1983	324	52	259	13	
1984	328	59	255	14	
1985	<u>302</u>	<u>49</u>	<u>244</u>	<u>9</u>	<u>—</u>
TOTAL	3096	612	2293	175	16

TABLE 3
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
LONG RANGE AIRCRAFT
1976-1985

<u>YEAR</u>	<u>WORLD</u>	<u>U.S. SHARE</u>		<u>CONTESTED</u>
		<u>HIGH</u>	<u>LOW</u>	
1976	43	43	43	0
1977	50	50	50	0
1978	66	66	66	0
1979	85	85	85	0
1980	70	70	70	0
1981	72	72	72	0
1982	66	66	66	0
1983	52	52	52	0
1984	59	59	59	0
1985	<u>49</u>	<u>49</u>	<u>49</u>	<u>0</u>
TOTAL	612	612	612	0

TABLE 4
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
SHORT/MEDIUM RANGE AIRCRAFT
1976-1985

<u>YEAR</u>	<u>WORLD</u>	<u>U.S. SHARE</u>		<u>CONTESTED</u>
		<u>HIGH</u>	<u>LOW</u>	
1976	146	125	125	0
1977	134	112	112	0
1978	152	130	130	0
1979	197	175	175	0
1980	294	272	87	185
1981	332	310	61	249
1982	280	259	63	196
1983	259	236	61	175
1984	255	232	61	171
1985	<u>244</u>	<u>221</u>	<u>61</u>	<u>160</u>
TOTAL	2293	2072	936	1136

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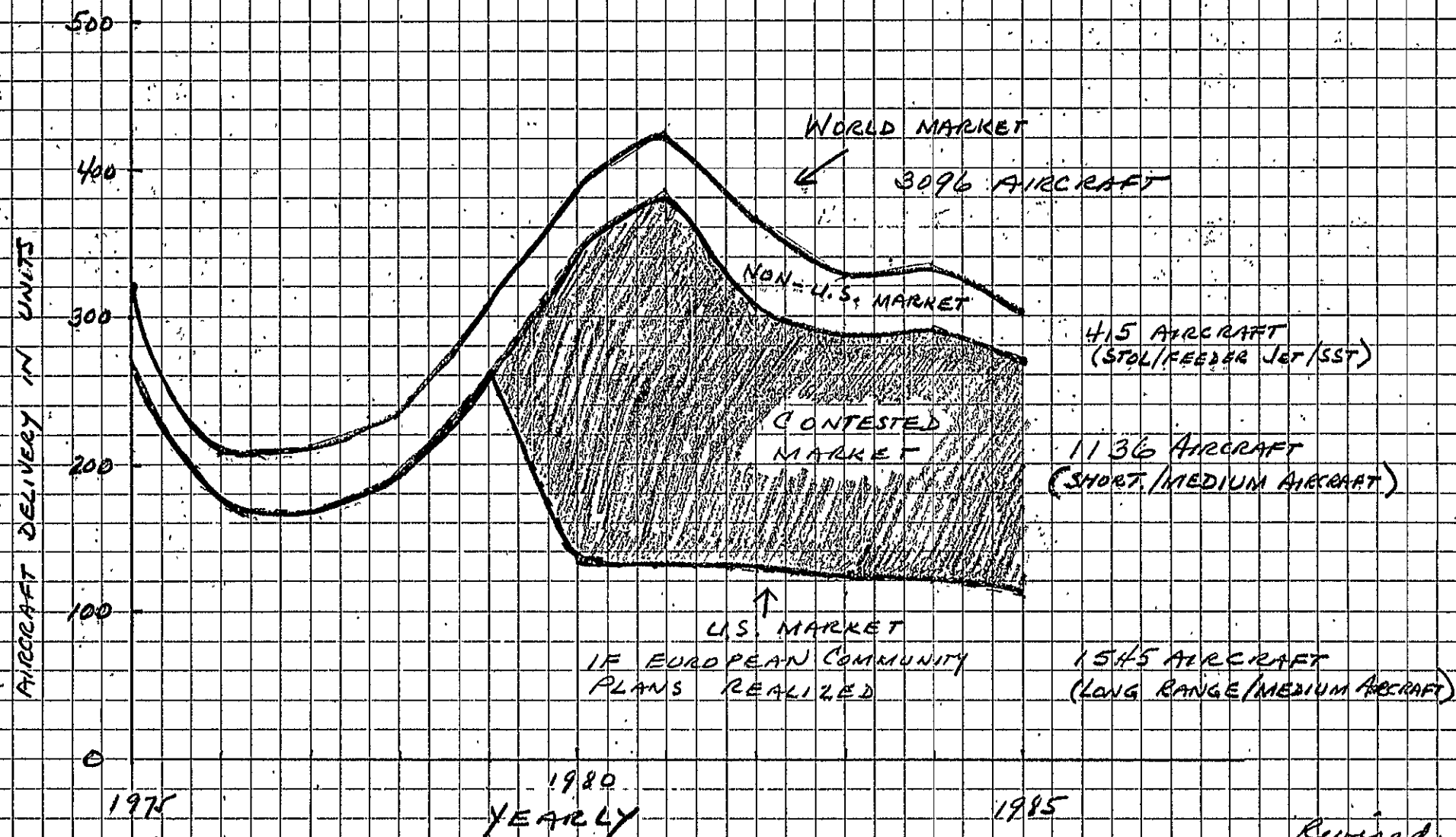
TABLE 5
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
STOL/FEEDER JETS
1976-1985

<u>YEAR</u>	<u>WORLD</u>	<u>U.S. SHARE</u>		<u>CONTESTED</u>
		<u>HIGH</u>	<u>LOW</u>	
1976	18	0	0	0
1977	24	0	0	0
1978	16	0	0	0
1979	24	0	0	0
1980	18	0	0	0
1981	18	0	0	0
1982	21	0	0	0
1983	13	0	0	0
1984	14	0	0	0
1985	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	175	0	0	0

TABLE 6
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
SST
1976-1985

<u>YEAR</u>	<u>WORLD</u>	<u>U.S. SHARE</u>		<u>CONTESTED</u>
		<u>HIGH</u>	<u>LOW</u>	
1976	5	0	0	0
1977	8	0	0	0
1978	3	0	0	0
1979				
1980				
1981				
1982				
1983				
1984				
1985	—	—	—	—
TOTAL	16	0	0	0

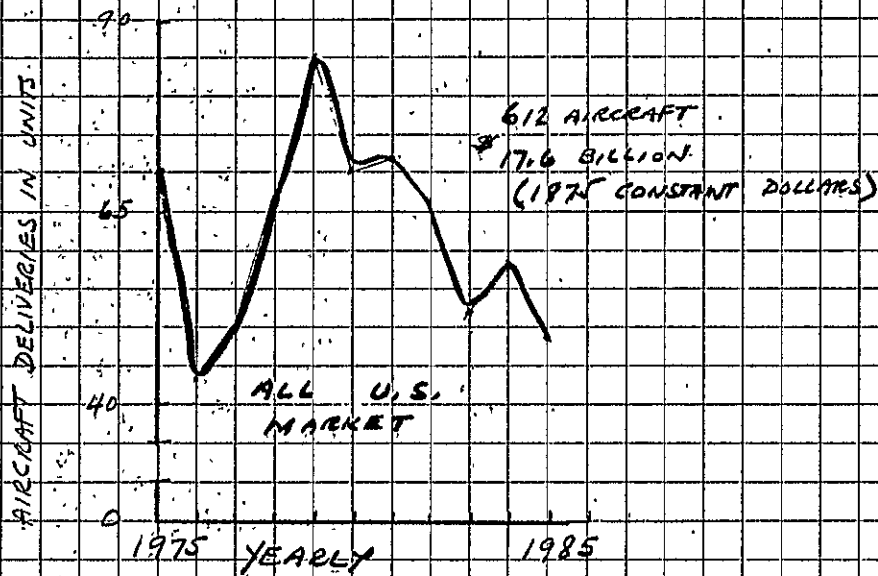
WORLDWIDE CIVIL TRANSPORT MARKET
ESTIMATED WORLDWIDE SHIPMENTS
BY TYPE AND MARKET
1975 - 1985



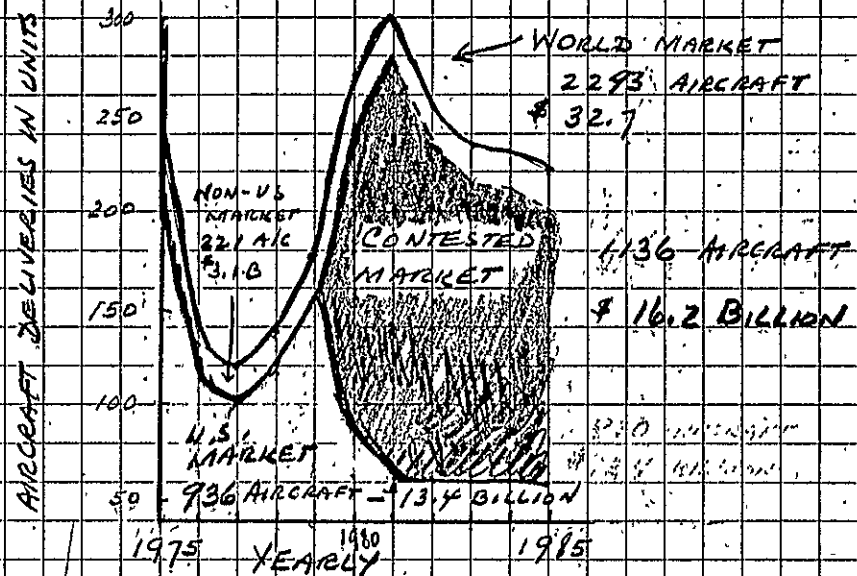
SOURCES: BOEING, STEINER PRESENTATION TO SUBCOMMITTEE ON AVIATION, MAY 1976
DOUGLAS, THE PASSENGER AIR TRANSPORT MARKET, 1975-1990, JUNE 1975

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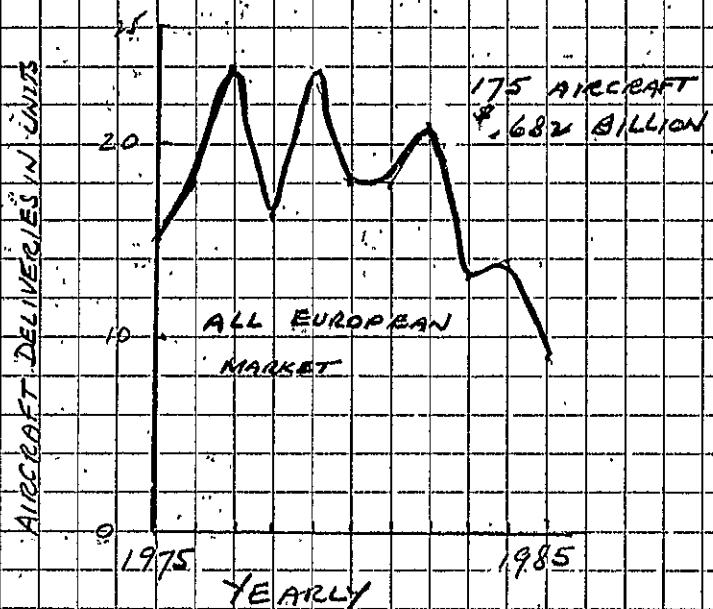
LONG RANGE



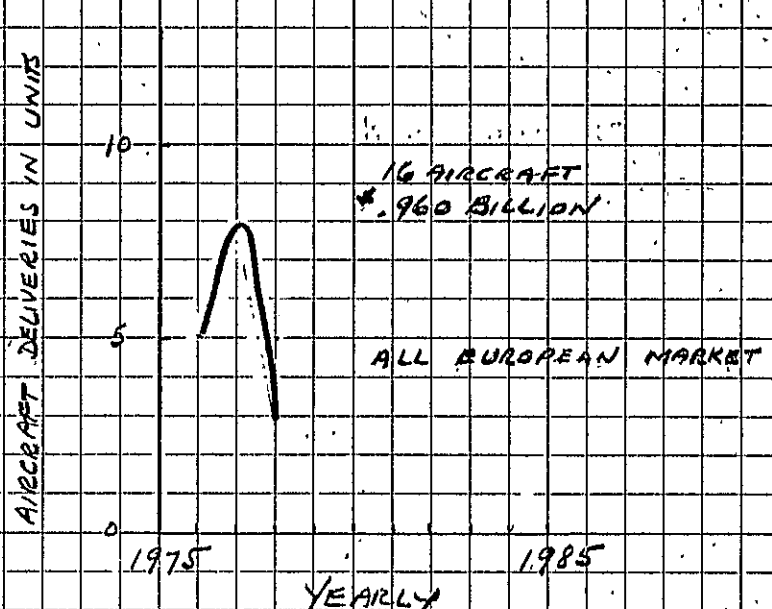
SHORT / MEDIUM RANGE



STOL / FEEDER JETS



SST



SOURCES: BOEING, STEINER PRESENTATION TO SUBCOMMITTEE ON AVIATION, MAY 11, 1976
DOUGLAS, THE PASSENGER AIR TRANSPORT MARKET, 1975-1990, JUNE 1975

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ORI

Operations Research, Inc.

1400 Spring Street, Silver Spring, Maryland 20910

Telephone: 588-6180, Area Code 301